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Alaska Forest Resources

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Journal of Forestry

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Alaska—Modern Pioneering

B. Frank Heintzleman

THE FINE FUTURE so frequently pictured for Alaska depends, in large measure, on the interest of Alaskans generally and their state officials in making a proper start in natural resource development and management during the present formative period of state government. The pattern set now will have a continuing influence on the rate of growth and stability of the population and on the opportunity to gain and maintain the American standard of living and way of life.

With an area one-fifth of that of the other 49 states combined, and with a present population of but one person to three square miles, versus an average population density in the other states of 55 persons to the square mile, Alaska offers much room for growth. It is a pleasure to note too that pioneering here and in this age need not necessarily involve the privations and hardships that were too often features of pioneer western settlement in the second half of the nineteenth century. The modern settler can draw on a vast amount of information on the nature and proper management of resources which was wholly unknown to the westerner of those earlier days. Equally important, he has available a great variety of facilities and appliances that make for easier living, and the great boon of modern transportation which has eliminated much of the inaccessibility and isolation long associated with new settlement.

In view of all of this, Alaska should be able to contribute substantially to the easing of those national population pressures which are forecast for some decades directly ahead. But the task of making Alaska a good place to live for a significant portion of our country's future population will not be achieved without an orderly development and careful management of its natural resources in the interests of the long-term as well as the short-term public good.

Informed and sympathetic legislators and state administrators and aggressive, competent resource managers should take the lead in working for this type of resource use as a sound basis for settlement of the vast wilderness which presently comprises all but a minor fraction of Alaska.

Certainly, the possibilities of doing a high-class job on a grand scale in Alaska excites the imagination and stimulates the thinking of all of us who are concerned with the present and future of resource administration and management in America. The men called upon to "break the ground" in this planning job and to set up the management procedures should be visionaries in the good sense of that term, but also they should be men who, while recognizing the necessity for compromise and possibly some mortgaging of the future in the case of emergencies, will stand firm against "ditching" the program.

The foundations should be laid and the guidelines established now for long-term state wide growth. Detailed plans should also be provided immediately for the regions showing the greatest promise of early development. As population and industry tend to extend farther and farther out from existing community and transportation centers the detailed plans should be extended to the new areas. This procedure will serve to block *boom and bust* types of development or a pattern of disconnected and unrelated growth in the various parts of this large state.

No western state on its admittance to the Union was given opportunity even approaching that given Alaska to determine the manner in which the natural resources within the state are to be managed.

The Statehood Enabling Law enacted by Congress in 1958 allows the new state to select 103,400,000 acres of federal lands, largely from the unappropriated and unreserved public domain, as a free

THE AUTHOR is former Governor of the Territory of Alaska (1953-1957) and former regional forester of the Alaska Region, U. S. Forest Service, Juneau.

grant for the support of the state government and public institutions, and the development of communities. This land grant is larger than the entire area of the State of California and will embrace 30 percent of the total area of Alaska. The selections to be spread over a period of 25 years need not be in one or a few tracts but can be spotted throughout the federal public domain which now embraces most of the area of the state.

In addition to the above, the Statehood Act transferred to the state government the control of the tideflats and submerged lands to the 3-mile limit along the thousands of miles of shorelines of Alaska's mainland and adjacent islands. These holdings have high present and potential values for their commercial fishing and possible petroleum resources, and as water front occupancy sites for industrial enterprises and other uses.

In fully and intelligently exercising its right of land selection the state can be expected to acquire the lion's share of these upland resources which are likely to become economically valuable in the next 40 years. These holdings, along with the valuable off-shore lands, and especially the important water-front property, make the state a far more important factor in resource management in Alaska than the federal government. As the latter will continue to administer the remaining 70 percent of the state area, here is a situation that clearly calls for coordinated planning and harmonized management policies of the resources of the two types of holdings.

The state government began to function when the first legislature convened in the spring of 1959. The system of resource administration established at that time indicates that the state is preparing to tackle the problems of resource management and use with a good perception of the desirability for considering future need, as well as present values.

It is also pleasing to see that the federal agencies operating in Alaska are showing a strong disposition to work for a good relationship in the management of federal and state resources.

Some of Alaska's resources are already coming within economic range of the markets of the U. S. and the Oriental and other Pacific Rim countries. Therefore, no time should be lost in starting work on plans for the use of the publicly owned resources which comprise practically 100 percent of the total.

Three-fourths of the area of Alaska lies south of the Arctic Circle and the Scandinavians have fully demonstrated the possibilities for industrial development and satisfactory living and working conditions in the subarctic regions.

It is likely that the expected further development of Alaska in the near future will be based on the mining of precious metals, strategic minerals, base metals, and coking coal and other nonmetallics; on further utilization of the vast forests for pulp and other timber products; on the production of petroleum from the large area of possible oil-bearing geologic structures; on the extension of commercial marine fishing to plentiful but presently largely untouched species of bottom and so-called "scrap fish" for which a market in the Orient might be developed.

Recreation and tourism will undoubtedly expand rapidly due to outstanding scenery and an abundance of big game animals and sport fish.

The extensive water power resources, which include some of the largest power sites on the continent, offer possibilities for the processing of local ores and also of imported ores (such as bauxite for aluminum) which require large quantities of low-cost power.

Agricultural research in the northern countries of the world has made possible the production of many food plants in the subarctic regions. The rolling plains and mountain grazing lands of interior Alaska can be expected to come into use gradually as a source of supply for many staple food items for local use.

Large scale mechanized farming is likely to be the rule. Conditions in Alaska and present day demands of Americans for good living conditions are not conducive to the subsistence farming plan for gaining population which characterized much of the earlier western settlement.

Increased population could come with the force of a mighty flood if the intensive petroleum explorations, now underway, bear out the optimism of geologists and engineers in charge. Oil might do for Alaska what gold did for the growth of the then new State of California in the 1850's. State and federal planners and administrators must thus reckon with the possibility of a sudden and huge influx of new residents at any time. Such a situation could greatly complicate the problems of orderly inventorying and planning for state development.

It is encouraging to note that the public forestry agencies and the timber-using industries now coming into Alaska are actively planning for the future of the great forest resource. The recently established Alaska Section of the Society of American Foresters disclosed that 100 graduate foresters are now working in the state in public and private employment. Because of their broad training and keen interest in the management of all kinds of natural resources, foresters can and doubtless will exert great influence in the proper shaping of Alaska development. They can be seen as stimulating official as well as public consciousness of the need for well organized planning and as actively participating in the planning work for *all* classes of natural resources. Alaska should thus be a highly satisfying field of work for foresters with the broad view. Perhaps never again will they have the opportunity of assisting in bringing the resources of many millions of acres of virgin land under orderly, productive management, working practically from "scratch."

National Forests in Alaska

Mason B. Bruce

MODERN ALASKA presents many challenges to land managers. Separated in latitude and longitude from its parent states, Alaska has lands and forests with characteristics not familiar to most professional foresters. The geography, climate, vegetative types, and almost completely virgin status, along with transportation difficulties, a thinly spread population, and high costs of labor and freight, all present unusual utilization and management problems. Notwithstanding such variances and handicaps, recent events indicate that Alaska is entering an era of development and utilization. Those who may have the desire to pioneer in a new and exciting country, and to participate in its development, will find Alaska the last such opportunity in these United States. It is within this unique portion of the country that the most northern and western extension of the national forest system is found.

Coastal and Interior Forests

Those who are not familiar with Alaska must first establish the difference between the so-called coastal and interior forest zones. This difference is simple and unmistakable. It is significant in the development and growth of the wood-using industry in Alaska.

The dense hemlock-spruce forests of coastal Alaska are an extension of the rain forests of the Pacific Northwest and British Columbia. Although this forest zone extends along the coast of Alaska for almost a thousand miles, it occupies less than 10 percent of the area of the state. Within these seaward slopes, extending from the British Columbia border in a northwesterly direction to the vicinity of Kodiak, are Alaska's national forests.

Commercial forests within the coastal zone seldom are continuous over large areas or watersheds but are interspersed with rugged mountainous outcrops, muskegs, unmerchantable timber, lakes, and streams. Behind the low timbered areas are bold, steeply dissected mountains, often carrying permanent snowfields and glaciers that frequently spew into the sea. Only about one-fourth of the land can be classed as commercial forest.

The contrast between this coastal area, which has a relatively warm and humid climate tempered by the Japanese current, and dry, cold interior Alaska is marked. The forests of the interior are extensions of boreal forests which border the arctic tundra regions of the continent. Basically they are white and black spruce forests with frequent admixtures of white birch and aspen.

The National Forests

There are two national forests, the Tongass and Chugach. Jointly these two units occupy about 21 million acres, or 6 percent of the entire area of Alaska. Unlike any other national forests, almost one-half their combined area is on islands, while the mainland portion is deeply cleft by navigable channels, bays, and inlets. They have over 10,000 miles of coastline and it has been estimated that 75 percent of the commercial timber is within 2-½ miles of tidewater.

FIG. 1.—Map of Alaska showing national forests.

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They have been organized into three administrative forests and, at present, are further broken down into eight ranger districts.

Timber.—These national forests include the major timber producing lands of the coastal area. The timber stands in many respects are unique. They are typical rain forests with large trees and heavy underbrush. The usual mixed commercial forest stand has a heavy main cover of hemlock with some cedar. Frequently overtopping this is more light-demanding spruce, which occurs singly or in groups. Stand volumes may run as high as 100 M board feet per acre. However, over extensive areas an average of about 35 M board feet per acre can be expected. More than 95 percent of the forest areas are in virgin condition. Originally, they may have been even-aged, but the lack of a fire history, due to heavy and continuous precipitation, or artificial vegetative manipulation has resulted in stands of uneven-age. Old age, insects, disease, and other natural factors through the ages have developed openings of various sizes in which new trees have become established, thus contributing to that characteristic. Studies have indicated that, although the average stand per acre of commercial forest land is now about 35 M board feet per acre, the typical second growth stand will produce almost double this volume during a rotation period of 110 years.

An inventory of the Tongass Forest, which is nearing completion, shows 92 billion feet as gross volume on what is presently considered to be operable, commercial forest land. Western hemlock makes up 64 percent of this commercial volume, Sitka spruce 29 percent, and combined western red and Alaska cedars 7 percent. There are minor quantities of cottonwood and red alder which are found on deep valley soils. There is estimated to be an additional volume of commercial forest land classed as inoperable, due chiefly to lack of accessibility, which amounts to 54 billion feet.

The same general character of forest that is typical of the Tongass extends to the Chugach Forest. However, individual trees become shorter and cedar drops out of the stand. On the Kenai Peninsula a transition to the interior types occurs and such species as white spruce, paper birch, and aspen appear to various extents in the stands. The western limit of commercially operable Sitka spruce on the continent is reached on Afognak Island.

Timber quality throughout both forests is predominantly of a pulp type with substantial volumes of higher grade spruce and hemlock growing on more favorable soils. Currently, at least two-thirds of the overall volume is suitable only for pulpwood. The remaining third can be used effectively for sawtimber and veneer.

Wildlife.—Alaska is a sportsman's paradise. Game and fish are bountiful in the coastal forests. As yet, hunting pressures have not been intense enough to materially alter original populations except in the vicinities of settlements. The coastal area abounds in Sitka deer, brown and black bear, while mountain goats are frequently seen at the higher elevations. Dall sheep are common in the mountains of the Kenai Peninsula, along with moose which are common in lowland areas. A thriving population of introduced Olympic elk occupies Afognak Island at the western extreme of the Chugach Forest. Salmon and halibut abound in coastal waters and are utilized both commercially and for sports fishing. Lakes and streams are found everywhere. They support excellent populations of steelhead, rainbow, cutthroat, and Dolly Varden trout as well as migratory salmon in those waters not blocked from the sea by natural obstacles.

Recreation.—The recreation potential of the coastal area is tremendous. The intricate network of narrow navigable bays, inlets, and other waterways bordered by wooded slopes, high, rocky crags, waterfalls, and ice flows affords scenery beyond compare. Such scenery, together with the opportunities for enjoying wildlife and finding solitude, provide a resource of unsurpassed value.

Early Development

Much of the early settlement and development of Alaska came about as a result of prospecting and mining. Gold was the primary metal sought; however, much of Alaska is mineralized and a number of promising ores have been located. Unfortunately, lack of economical transportation to world markets, coupled with the high costs of extraction, led to the early closing of mining ventures, except those where particularly rich ores made it possible to overcome these difficulties.

Water is a plentiful commodity in coastal Alaska. Its potential as an income-producing resource is tied to power. Availability of cheap power would do much toward stimulating industrial use of the state's resources. Cheap power tends to overcome the adverse effects of costly labor and transportation.

The earliest interest in withdrawing forest lands in Alaska for management purposes dates back to 1892 when the Afognak Forest and Fish Culture Reservation was established under the jurisdiction of the U. S. Department of the Interior. The Chugach National Forest was established in 1907. The next year the Afognak Forest and Fish Culture reserve was abolished and added to the Chugach. The Alexander Archipelago Forest Reserve was established in 1902; however, it was not until 1907 that the Tongass National Forest was created. In 1908 the Alexander Archipelago Reserve and Tongass National Forest were combined and called the Tongass National Forest.

During these early years, substantial additions, as well as eliminations, were made to both forests. Among the more important eliminations, were those for the Glacier Bay National Monument and the Kenai National Moose Range.

It is worth while to consider why these national forests were created in the coastal area. Why were these

valuable resources selected for continuous supervision of a land managing agency such as the Forest Service? The period in which these forests were created was one during which there was much pressure in the country for preserving large blocks of remaining public domain in the form of national forests. The eastern and central forests had been ruthlessly exploited for private gain. Strong private interests had taken aggressive steps to acquire and control large blocks of the remaining resources of the country. The last remaining virgin timber stands were in the West and Alaska. Indications were that these forests would follow the same pattern of private acquisition and rapid exploitation unless steps were taken to place substantial areas under public management. The principles of sustained yield and multiple-use management were being espoused by a group, prominent among whom were Gifford Pinchot and Theodore Roosevelt. It was logical to assume that some day Alaska would become a state and that the type of use pressures being met elsewhere in the country would eventually extend to Alaska. Sound long-term development of Alaska's important timbered areas needed prevention of unwise and selfish alienation, and orderly development with specific management objectives. The obviously valuable resource potentials required advance study, evaluation, and correlation, if their full capacities were to be utilized to the public's advantage. It was with these objectives in mind that the national forests of Alaska were created.

W. A. Langille was sent to Ketchikan as supervisor when the first Alaskan forest areas were placed under administration in 1902. He continued in this capacity when administration was transferred to the Forest Service in the Department of Agriculture in 1905. In this assignment he supervised both the Chugach and Tongass Forests.

The problems encountered by Mr. Langille were formidable to say the least. Here, in one of the most remote regions of the continent were huge, undeveloped areas to be administered. There were only a small number of people living within the forests and few of these had any interest in land management or long-term planning and development. Many were transients bent upon making a stake and getting out. Probably the native population was the most stable one. Transportation was by water, more often than not in stormy weather and in exposed seas. Communications, except by boat-transported mail, were nonexistent. The cost of labor and supplies was high.

Although industry was interested in exploiting the minerals and fisheries resources of the area, such interest was wholly of an extractive nature with the paramount idea of quick profit. Outside capital financed all such ventures and any profits that were realized seldom remained in the area. Speculators were aggressive in attempting to obtain title to blocks of land which might eventually prove of real value.

In these early days the Alaska national forests were administered as a part of the Pacific Northwest Region with headquarters in Portland, Ore. It was not until 1921 that the Alaska Region was formed with a regional forester, C. H. Flory, headquartered in Juneau. Mr. Flory continued in this office until 1937, at which time he was succeeded by B. Frank Heintzleman.

Early-day management of the forests could only be described as custodial. The administrative organization was small, water transported, slow moving, and hard pressed to accomplish much except to protect the lands from fire, trespass, and unwise encroachment. During this period it was possible to map the area, obtain an idea of the extent and nature of various resources, and speculate upon policies for future management.

There was early recognition of the need for forest research as a basis for planning. In 1924 the first research efforts were started and were conducted by the administrative branch of the Forest Service. This important work was discontinued in the middle thirties, except for the remeasurement of permanent plots. It was resumed in 1948, at which time the Alaska Forest Research Center was established at Juneau, under the direction of the Research Branch of the Forest Service.

Under the difficult circumstances

FIG. 2.—Aerial view of lake at headwaters of creek entering head of Port Haughton looking east, Tongass National Forest.

of transportation, communication, available manpower and cost, and the lack of incentive for industrial and community development, it was not surprising that little in the way of effective forest management was realized. The greatest contribution to future management of the forests during these early days appears to have been the controlling effect by the Forest Service in preventing excessive and unwise alienation of public lands—alienation that would hamper development of resources when the time became ready.

The CCC program of the thirties was extended to Alaska and provided a sample of what could be expected in the way of public development when the Alaskan forests assumed their proper place in the national forest system. However, the size of the job ahead was such that the CCC effort could only be considered a gesture toward management. Needed as an impetus toward management was pressure for the various uses which the forests were able to provide. The great depression of the thirties successfully curbed any significant industrial development and its correlating population and community pressures.

Industrial Use

It should be noted, however, that persistent efforts were made to develop a wood-using industry in Alaska. Since the early beginnings of the national forests there have been a number of small mills manufacturing for local consumption and export. The oldest continuous operation is Ketchikan Spruce Mills, which had its origin in 1898. There has been an active demand for fish boxes and numerous small mills manufactured this product intermittently. Small mills of this nature have come and gone. Few have been really successful over a period of time primarily because profitability depended upon an export market, and the only profitable materials to export were top grade clears and shop. Common grades could only be disposed of through local markets and such markets were not extensive enough to support substantial production. Fish trap logs and piling always were marketable commodities for local use and often during the early days made up the backbone of timber business.

The annual cut from the forests increased from 8 million board feet in 1909 to 55 million board feet in 1927, and was 43 million board feet in 1936. In 1950 the annual cut was 60 million board feet.

Interest in pulping opportunities extends back to about 1910. In 1913 the Forest Service offered 300 million board feet on the Stikine River, with a period of 20 years for removal and a reserve of an additional 300 million for future supplies. The applicant was unable to finance the enterprise. Following this, in 1917, a billion feet of timber were offered in the Behm Canal area but again the applicant could not finance the deal.

The Alaska Pulp and Paper Company, in 1920, applied for 100 million feet to supply a plant it later built on the Speel River. The mill shipped 100 tons of groundwood pulp to Seattle, but the low price of pulp and high freight rates made the operation unprofitable. The plant closed in 1923, and the sale agreement was cancelled in 1925.

Two large pioneer pulp-timber contracts were undertaken in 1927. Although substantial sums were spent on development surveys, the onset of the business depression in the early thirties brought development to a standstill. In 1933 both contracts were cancelled by mutual consent. From this time until

FIG. 3.—Neets Bay operation of the Ketchikan Pulp Company on Revillagigedo Island. Boommen guiding logs into position for tying into bundles. Groups of these bundles of logs are then made into rafts and hauled by tugs to the mill at Ward Cove.

FIG. 4.—Ice skating on Mendenhall Lake in front of Mendenhall Glacier near Juneau, Alaska. Corner of skaters' cabin, built by the CCC, in left foreground.

the beginning of the Second World War sporadic interest in pulp ventures was encountered. Interest revived after the war.

A small plywood plant began production in Juneau in 1953, and made a product that was well accepted by the trade. From the outset this venture encountered financial difficulties, and in 1955 it was forced to shut down. During 1959, while retooling for renewed production, it burned to the ground.

Development of Pulp Industry

It was in 1951 that the Ketchikan Pulp Company entered into a 50-year contract with the Forest Service for 8.25 billion feet. A chemical pulp mill, which manufactures a high grade of dissolving pulp, was completed in 1954. The mill, which cost in excess of 50 million dollars, has operated successfully since that time. Its daily capacity is between 550 and 600 tons.

The date 1954 was a significant one in the history of Alaska's national forests. It marked the turning point between the custodial and management eras. From this date, which was some 50 years after the start of the national forest system in Alaska, major effort has been directed to management practices that will insure continuous use of all forest resources. Although the immediate demand was for timber, correlation with existing and proposed resource uses became a specific and immediate problem.

Within a year after opening of the Ketchikan pulp mill, the Forest Service entered into three additional long-term agreements which provided for pulp development in Alaska. These were with the Alaska Lumber & Pulp Co., Inc., calling for a mill at Sitka, the Pacific Northern Timber Company with a mill near Wrangell, and the Georgia-Pacific Alaska Company based upon a mill in the Juneau area. Of these three ventures, the Japanese-owned Alaska Lumber & Pulp Co., Inc., alone has advanced to the point of opening a 450-ton high alpha cellulose pulp mill at Sitka in late 1959. The Pacific Northern Timber Company, which contemplates a joint sawmill and pulp venture, has progressed to the point of erecting a modern sawmill at Wrangell.

Changing Demands

Needless to say, increased timber demands and other current activities are bringing about rapid changes in Forest Service activities in Alaska. In 1959 Alaska became a state with the attendant publicity that such a change was bound to create. Increased population, associated with the new industries, plus a sharp step-up in tourist visits already strain the accommodations and facilities available in coastal Alaska. Plans are being formulated to install a fast passenger and automobile ferry system connecting the highway, which now terminates at Prince Rupert, British Columbia, with the larger communities in Southeast Alaska. This will also provide a connection at Haines with the Alaska Highway, thus permitting tourists to make a circuitous trip through Alaska by automobile. Serious discussions are likewise under way calling for new road links to the interior highway system from Juneau, Petersburg, Wrangell, and Ketchikan. If only a portion of these planned improvements materialize, coastal Alaska will find itself deluged with tourists bent upon enjoying the magnificent scenery, glaciers, water, and wildlife that heretofore have been available only to those few who could afford air and steamer accommodations.

Where once timber harvesting activities were largely confined to obscure islands and bays, they now are becoming widespread and raising real problems of coordination with recreation and wildlife uses. Ranger district organizations are being enlarged and new districts created to meet the increased responsibilities. Just a few years ago major attention was centered on protecting the forest resource from unwise encroachment and physical damage, whereas it is now focused on coordinated use of several highly valuable resources.

Alaskans are keenly conscious of their thinly scattered population and realize that if the state is to be self-sustaining, there must be full use of its resources with corresponding population and community development. Wood-using industries promote labor and communities and provide a tax base. These are concrete and measurable things which are sorely needed. With careful planning and coordination, such communities can be expected to provide centers from which the recreation and wildlife resources can be used and enjoyed. Scenic areas of national significance such as Tracy Arm, Fords Terror, Mendenhall, Portage, and Columbia Glaciers all are within the national forests and constitute major attractions. There are many other less publicized recreational areas which, if protected and developed, will provide the basis for additional recreational use.

The wildlife resource is rich and varied with an important economic potential. Heavy populations of deer which now exist in many areas are becoming known to out-of-state hunters. The moose, elk, Dall sheep, goats, Alaska brown and glacier bears have attracted great interest and are susceptible to profitable use on a sustained basis, under a coordinated form of management.

Although mining activity in Alaska has been in the doldrums for a number of years, it can be expected that, with changing conditions of supply and demand, improved transportation, and the development of cheap power, Alaska ores will become more competitive on world markets. Currently increased exploration of oil, gas, coal, and metallic ores indicates that such conditions are approaching reality. The national forests are important sources of these natural resources.

Important to the development of all resources in the coastal area are substantial blocks of economical power. Hydroelectric installations appear to be the answer to this need for some time to come. Coastal rivers and lakes are receiving renewed study in answer to increased demands for this commodity.

Resource Pressures Mount

It takes little imagination, therefore, to picture the effect of these resource use pressures on national forest administration at this time. The management era is here. It cannot be ignored or discounted. It is what the founders of the Alaska national forest system looked forward to at the time of its creation.

Since there have been national forests in coastal Alaska for 50 years, it could be assumed that all necessary information needed for a management program has been obtained and is at hand. Such is not the case. Worldwide concepts of demand, value, and marketability constantly change with new technical developments, use patterns, and pressures. What constituted an adequate resource inventory 20 years ago is now completely obsolete. To meet the problems of expanding use of the national forests, there is need for up-to-date inventories of all resources. Changing economic pressures require constant reappraisal of utilization possibilities. Population pressures and development objectives change constantly and must be coordinated with these resource inventories and planned uses.

Research on productivity, management, and protection in terms of present day technical advances is sorely needed. Without it long-term planning loses much of its effectiveness. Transportation facilities for resource access, power for development and economical use, and risk capital for expansion all must be explored and provided. Needed, perhaps more than anything else at this time, is thoughtful and painstaking planning to obtain wise correlation of uses—what is commonly called multiple-use management planning.

The region has reprogrammed its resource planning to meet these needs. A comprehensive inventory of the timber resources of both the Tongass and Chugach has been under way for some time. Working circle timber management plans are in preparation. A major transportation planning project, contemplating several thousand miles of utilization roads, has been completed. During 1960 an inventory and projection of recreational use demands should be completed. This will provide a basis for sound recreational development of the national forests. Research on regeneration, growth, utilization, and insect and disease losses, while often inadequate to guide current activities, is progressing and, it is hoped, can be enlarged.

Studies of the effect of timber harvesting upon salmon streams and salmon production have been carried on for some time and will be continued. The effect of multiple-use development upon the Alaska brown bear and coordination measures that are needed to maintain populations of this unique wildlife species are important and are under way.

Coordination of Uses

Multiple-use planning, an integrating process to bring about successful coordination of individual resource plans and assure that all resource uses and productivities are safeguarded, is being initiated.

Successful accomplishment of these management measures calls for close cooperation with and understanding by related departments of the new State of Alaska. As these new branches of the state are organized, measures to obtain effective coordination are being undertaken.

The passage of time has not changed materially the long-term objectives which were contemplated in creating the national forests of Alaska. Viewed in terms of modern pressures, trends, and economics, the future contributions of this form of land management include the following:

1. Provision for orderly development of the several resources and uses which forests provide;
2. Establishment of sustained yield management of each resource on a multiple-use basis, with safeguards provided to obtain effective coordination of uses;
3. Assurance that the land will be maintained in a productive condition—productive of all resources as contrasted to a single resource;
4. Provision for safeguarding the public interest in the resources, uses of which are vital to economic progress and community stability, and the prevention of unwise exploitation based solely on private gain;
5. Investment in the future through developmental programs and the foregoing of maximum and immediate capital returns to the government in order that sound and productive, long-term use may be assured; and
6. Participation in the development and growth of local communities through annual returns from a share in the receipts from the national forests.

Alaskans are vigorous, hard working and determined people. They are convinced that growth and stability of the new state are tied to early development and use of its natural resources. The national forests of Alaska can be expected to play an increasingly important role in efforts to attain these objectives.

The Alaska Public Domain

Eugene V. Zumwalt

THE NEW State of Alaska encompasses the 586,400 square-mile area purchased from Russia in 1867. It is almost as large as California, Oregon, Washington, Idaho, Nevada, and Utah combined. Marking the last sizeable addition made to the original public domain of the United States, this vast land heritage of the American people has remained down through the years almost completely in federal ownership.

Only one percent of the 365 million acres of land in Alaska has passed into private hands, notwithstanding availability of most of it for settlement under provisions of the various public land laws. About 92 million acres, roughly one-fourth of the state's area, have been set aside for national parks, monuments, wildlife refuges, national forests, oil and gas reserves, and other federal reserves under jurisdiction of several federal agencies.

By far, the largest landlord in Alaska is the Bureau of Land Management in the U. S. Department of the Interior which has exclusive jurisdiction over 299 million acres, or 82 percent of the total land area. Of this, 270 million acres are classed as "vacant" public domain —unreserved and unappropriated. Actually, they are a storehouse of natural resources destined to play an ever growing part in the economy of the state and nation. The basic land, forest, range, water, mineral, and wildlife resources are abundant as are majestic mountain ranges and unsurpassed scenery, all of which augur well for the state's stable and progressive development.

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In administering, managing, and protecting these lands and resources under multiple-use concepts, the Bureau of Land Management operates under a decentralized organization with an area office in Juneau and operations offices in Juneau, Anchorage, and Fairbanks. Additional year-round field stations are located at Homer, Finger Lake, Big Delta, and McGrath and 11 fire control stations are scattered from the Kenai Peninsula to north of the Arctic Circle.

Responsibilities of this far-flung organization include maintenance of the basic land records and administration of the public land laws; processing leases and applications for mineral resources under the mining and mineral leasing laws; protection, administration, and sustained yield management of timber and range lands; and maintenance of the official engineering service for survey and resurvey necessary to the identification and description of the public lands.

The basic element of natural resource adminstration is the land itself. Therefore, the foundation of programs and operations of the Bureau is the administration of the public land laws. Such a program dates back to the early days of exploration and settlement of the western frontier. Under these laws over one billion acres of public domain lands have been transferred to private ownership and local governments.

As part of its lands function the Bureau also maintains the basic land records which are the source of original title for more than one billion 800 million acres of private and public lands. These records date back to colonial times. At present the Bureau is engaged in a large scale program to modernize these records, adapting them and their maintenance to the latest microfilm and punched card tech-

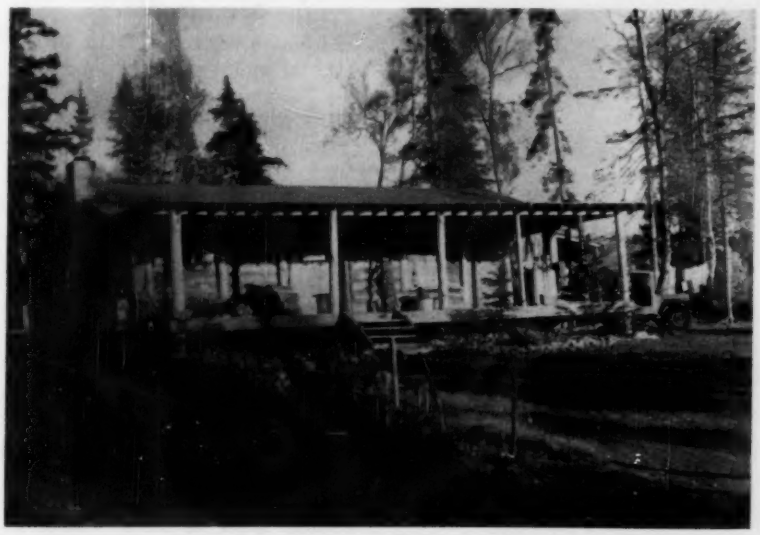

FIG. 1.—Homesteader's cabin near Anchorage.

niques. This work is now well under way in Alaska and will be largely completed during 1960.

Disposal of Public Domain Lands

Transfer of public domain lands in Alaska to private ownership has been a relatively slow process, which is normal in the pioneering development of new land. Laws are available for such purpose but the demand for land has been low. The population recently estimated at around 210,000 is principally in towns or their immediate environs with almost half of it in Greater Anchorage. While there has been interest by a rather large number of people in small tracts, homesites, town lots, trade and manufacturing sites and townsites, these total only about 18,000 acres of patented land, mainly in or near settlements.

Homesteads probably reflect to a greater degree the outward expansion of the population. However, here again one finds limiting factors that should be carefully investigated on the spot by interested homesteaders. These include the remote location of available lands since the most desirable sites along the roads have been taken; lack of utilities, access roads, and schools; the expense of clearing land and the difficulty of marketing agricultural products. Most of these factors must be seen to be properly evaluated. Many people interested in settling in Alaska over estimate what is available to them from the federal government and underestimate the problems and hardships involved in obtaining it.

FIG. 2.—Drilling shot hole—seismic exploration, Kenai Peninsula.

Despite efforts on the part of both federal and state agencies to inform people of the high costs of agricultural land development, there has been a recent acceleration in homestead entries. Many of these have been filed by Alaskans anxious to acquire land prior to state selection. There were 1,785 new homestead entries made from July, 1958 through June, 1959, an increase of 220 percent over the highest total for any previous fiscal year. Some 327,000 acres of homesteads have been patented down through the years, but only about 22,000 acres are now being farmed. Although provisions are now terminated, veterans could at one time obtain patent without the usual cultivation requirement.

There are probably a million or more acres of accessible farm land in the new state. Some crops grow very well providing land is heavily fertilized, but limited markets and high production costs coupled with competition from agricultural imports currently dictate subsistence farming rather than large scale production.

Grant to State

Although relatively static in the past, the public domain land pattern has started to change, particularly following the admission of Alaska as the 49th state on January 3, 1959. Under provisions of the Statehood Act of July 7, 1958 (P.L. 85-508: 72 Stat. 339) Alaska was granted and entitled to select 400,000 acres of open public domain as well as 400,000 acres of national forest lands for community and recreational development. Also, the state may select an additional 102,550,000 acres from open public domain, an area slightly larger than California.

The law provides that these selections must be made within 25 years following admission into the Union. It is expected that lands will be selected at an average rate of slightly over 4 million acres per year.

An additional 1 million acres granted under provisions of the Mental Health Act of July 28, 1956 (70 Stat. 711) must be selected within a 10-year period. Meanwhile, the Bureau of Land Management will continue to administer, protect, and manage the lands pending transfer of title.

As a service to the new state, the Bureau of Land Management has placed high priority on the processing of state selection applications. Also required before transfer of title may be effected is the determination and survey of existing valid rights contained within the selected areas as well as a boundary survey of the selected areas.

Recognizing the revenue potential of public domain along roads and near settlements, the state has placed a priority on the selection of lands in such locations. By December, 1959, the State Department of Natural Resources, Division of Lands, had filed 34 applications under the Mental Health Act for 272,000 acres of land and 39 applications under the Statehood Act for 647,000 acres. Plans call for accelerated selection now that the new state government machinery is in operation looking toward the acquisition of public domain mineral and forest lands.

Mineral Resources

Although gold and other hard rock minerals have been mined extensively in the past, they are now far over-shadowed by oil and gas leasing which is the largest present mineral activity on the Alaskan public domain. Oil exploration has been carried out for the past half century, but the strike on the Kenai Peninsula south of Anchorage on July 23, 1957 set off a rush of oil leasing of unprecedented magnitude.

The BLM Land Office at Anchorage was flooded with 5,700 filings within the first six months after the oil strike was announced. Later, the Fairbanks Land Office was

the focal point of comparable business. As of December 1, 1959 the Anchorage office had issued 6,696 leases since the oil discovery in July preceding, covering 14,394,863 acres, while the Fairbanks office issued 5,814 leases for 13,193,274 acres during the same period. Well over 4 million acres are involved in pending offers and additional offers to lease are currently being made. Counting 6.5 million acres under lease before the recent discovery, the 34 million acres now under lease covers an area approximately the size of North Carolina.

Oil and gas leases are issued under provisions of the mineral leasing laws and regulations applicable to Alaska for lands within the known geologic structure of a producing field, or as in the case of practically all the leases in Alaska, on a noncompetitive (wildcat) basis for lands not within a known geologic structure. The noncompetitive lease term is for five years with the privilege of one five-year extension, or if production is obtained, for so long as oil or gas is produced in paying quantities with a limit of 100,000 acres to any person, association or corporation upon payment of the prescribed annual rental. If production is obtained, a royalty must be paid depending upon the amount produced.

Since the 1957 oil strike there have been four other exploratory wells brought in on the Kenai Peninsula, the last one having a reported daily capacity of 428 barrels. The oil shows a test of high quality which is encouraging for the possible development of an Alaska oil industry. Substantial quantities of gas have also been discovered in wells on the Kenai Peninsula and in the Gubik area of northern Alaska.

Already 20 or more oil companies are operating within the state on an exploratory basis. They provide direct employment for approximately 500 people. In addition to the direct boost to the economy through payroll, the state receives 90 percent of all federal revenues from oil and gas leases. For the first half of the 1959 fiscal year the state's share was $4,333,835.57.

By law, the state may select mineral lands. Furthermore, lands under oil and gas lease may be selected for a period of five years following statehood. Mineral leases on such lands selected will be transferred to and administered by the state.

Public Domain Forests

Forests, the most extensive renewable resource on the public domain, cover an estimated 125 million acres, an area almost three times as large as the State of Washington. Due to the inroad of past fires, diseases and insects, limited accessibility, and other economic factors, probably around 40 million acres can be classed as commercial forest land. Of the total estimated volume of 350 billion board feet on all forest land, some 180 billion feet are of commercial character extending principally along the river valleys and lower slopes of those drainages. An estimated three-quarters of this volume is softwood, mainly white spruce. The remainder is mostly white birch and aspen which are pioneer species following past fires. Vast stands of cottonwood are found along the water courses.

The remaining 85 million acres of woodland have been severely ravaged by past fires resulting in a patchwork of timber types and inadequate stocking of younger age classes. Yet, herein rests the foundation of a vast potential resource development if given proper protection and management. It is estimated that four-fifths of the virgin spruce has been destroyed in the last 70 years. Although a tremendous task, the Bureau of Land Management is making progress in fire control. However, it remains an ever increasing problem as population grows, new roads are built, and the forests become more accessible to man. Details of this important program are discussed in another article of this issue of the JOURNAL.

The contribution of the pubile domain forests to the economy of Alaska is yet to be realized, for at present they are virtually untapped. The estimated producing capacity of commercial forest land is 1.5 billion board feet. That of woodlands adds another 800 million, bringing the annual total to over 2 billion board feet. Although the forests supply the cut of some 70 small sawmills, the total cut for 1958 fiscal year was only 20 million board feet, less than one percent of the allowable cut on a sustained yield basis.

Since probably 90 percent of the

FIG. 3.—Representative white spruce stand, interior Alaska.

lumber used in the interior is imported, there are opportunities for the local industry to capture an increased share of the market. Spruce trees are relatively small in size, averaging 18 to 24 inches in diameter when mature and produce mainly common grades of lumber so there are limits to local timber in the competitive field. However, by assuring a more constant supply and a better manufactured product the local forest industry should gain in stature as an integral part of the economy. Due to the ever-increasing price of imported lumber and high transportation costs coupled with very limited capital, Alaskans find adjacent timber to have a high in-place value.

Timber may be purchased on public domain from the Bureau of Land Management on a competitive bid basis. Small sales of not over a year's duration may be negotiated if there is no competitive interest. In either case, cutting must be done under contract which specifies approved forest practices.

The principal tree species on the public domain all are known to produce good pulp. The industry is now well established in Southeast Alaska, being supplied from national forest timber. The public domain forests to the north form a vast potential pulpwood reserve awaiting only a favorable combination of economic factors for pulpmill development. Also, the large stands of white birch offer opportunities in the export market to help supply the fast growing western furniture industry. Although only about 5 percent of the birch is of suitable size and quality required for rotary veneer, much of it could be sawed or sliced. In addition to the plywood possibilities, Alaska white birch has been shown by tests to make fine grade flooring, paneling, and small dimension stock.

Range Land

Interspersed among the forest lands and forming vast unbroken expanses throughout western Alaska including the Alaska Peninsula and Aleutian Islands are approximately 100 million acres of public domain range land. Not only do these lands support large populations of wildlife of many kinds, but large areas also hold potentials for grazing of domestic stock. So far, remoteness, high production costs, and limited markets have deterred any large scale capital investments to develop a livestock industry.

Vacant public domain range land is open to grazing leases under the provisions of the Alaska Grazing Act of March 4, 1927 (44 Stat. 1452). With a few exceptions, a lease may be granted by the Bureau for as long as 20 years covering an area of sufficient carrying capacity to support the number of animals designated by the lessee in his proposed stocking schedule. A grazing fee of five cents per animal unit month is charged.

On June 30, 1959 there was a total of 60 active grazing leases covering slightly over 2 million acres. Only eight of these leases are located in the interior while 49 of them encompassing 1.8 million acres are principally on Kodiak Island, the islands adjacent to the Alaska Peninsula, and the Aleutian Chain.

The severe winter weather of the interior precludes year-round grazing except on areas which blow clear of snow. Even then, successful livestock raising dictates supplemental feeding and some measure of protection to the stock during several months of the year. Hardy breeds capable of withstanding the onslaught of the elements are required. The Scotch Highlander cattle seem to offer advantages in this respect although relatively short use of the breed limits recommendations in this regard.

Kodiak and the Aleutian Islands receive the benefit of the Japanese Current and are not subjected to the low temperatures of the interior. There it is possible to graze throughout the year. However, stockmen have found supplemental feeding advisable. The grasses that grow in profusion and appear luxuriant during the main growing season do not cure well, and most of the nutrients are lost through leaching. Therefore, supplements of silage, cottonseed cake or other high protein feed is needed.

Reindeer Range

Recently the Bureau of Land Management was delegated the authority to issue reindeer grazing leases on public domain to Alaskan Eskimos and Indians. At present

FIG. 4.—Sheep on typical Aleutian range, Umnak Island.

FIG. 5.—Hereford cattle, Umnak Island, Aleutians.

there are 16 herds of reindeer numbering some 38,000 animals that graze on or near the Seward Peninsula. This is but a remnant of the initial importation from Siberia just prior to the turn of the century for the purpose of supplementing a depleted game resource which grew to an estimated 600,000 animals in the early 30's. These had dwindled to 26,000 by 1950.

There have been several reasons given for the sudden decline in numbers. These include overgrazing of ranges, lack of herding, losses through animals joining migrating caribou herds, killing by wolves, excessive slaughter and loss of interest by native owners. However, through diligent administration by the Bureau of Indian Affairs operating under the provisions of the Reindeer Act of 1937 (50 Stat. 902) and the predator control by the Fish and Wildlife Service, the industry is again on the upswing.

The present herd owners are desirous of obtaining grazing leases for specific areas in which their herds graze. This will foster better management through granting the natives more secure tenure on specified areas of sufficient size to carry on an economic operation.

Public Land Surveys

Prerequisite to the sound administration and management of the public lands are cadastral surveys which create and establish land boundaries. These surveys identify parcels of land on the ground by monuments and the official recorded field notes and plats afford descriptions and areas upon which the original patent and all subsequent transfers are based. From its genesis as an ordinance of the Continental Congress on May 20, 1785, the rectangular system of survey of the public lands of the United States has been extended to 74 percent of the total original public domain. About three-quarters of that remaining unsurveyed is in Alaska where only seven-tenths of one percent of the land is covered by either the rectangular net or special surveys of isolated tracts.

As the official agency charged with the surveys of the public lands, the Bureau of Land Management is engaged in an active program to completely modernize equipment, methods, and procedures to improve efficiency and accelerate output. Helicopters have been used successfully in transporting survey crews to and from remote areas. An electronic distance measuring device has proven very effective and extremely accurate in obtaining measurement of distance more rapidly than by conventional tape. The Bureau operates five such instruments in Alaska at the present time. The combination of helicopter, high speed distance measuring devices and one-second reading theodolite for azimuth is now being used to speed production on long boundary survey lines such as are encountered on state selection areas.

Swamp buggies, gasoline driven vehicles with extremely large tires offering increased bearing surface for traveling over muskegs and swamps, have proven valuable for transporting men and equipment over relatively short distances where air travel is not practical. Special tractors have also been effectively used for this purpose, as well as for line clearing to replace hand brushing.

Since less than 1 percent of Alaska has been surveyed, it was found necessary to devise some means of describing land parcels relative to their proper position on the ground in terms of rectangular system surveys. This is now being accomplished by protraction diagrams. These diagrams, each portraying 16 townships, show on paper the proper geographic position of all unsurveyed rectangular system township and section lines and the geographic coordinates for each township corner. Water areas are also shown. Most of interior Alaska will be covered by protractions by the end of 1960.

Correlation of photogrammetry with cadastral survey work is being given increased attention. Experiments by the Bureau in this field have proved successful to the extent that a photogrammetric survey unit has been established in Alaska. Electronic computers are being used in conjunction with photogrammetric phases to speed cadastral survey production.

All areas selected by the new state from the public domain must receive a boundary survey before a patent may be issued. In addition, all valid claims within the selected area must be surveyed. Since the selected areas may well run thousands of acres in size and total yearly area selected will approximate four to five million acres for the next 25 years, concerted efforts are being made to test applicability of all possible types of new equipment adaptable to the work.

Conclusion

Looking ahead into the future of the Alaskan public domain—its size will diminish perceptibly, principally through state selections. These will include most of the good forest land, potential agricultural land, many of the better range lands and those of mineral character. Thus will be carved a new state resource base from the original public domain, the traditional development ever since the beginning of these United States. Despite state selections, there will still be left in 1984, probably 166 million acres of vacant public domain less other entries under the public land laws. At that time this area, larger than California and Oregon combined, may prove to hold untold r e s o u r c e values not even dreamed of today.

Forest and Range Fire Control in Alaska

R. R. Robinson

ALASKA has a crucial forest fire problem. Since organized fire control began in 1940, areas burned have averaged 1.2 million acres annually. The largest loss of actual record occurred in 1957 when fires swept over 5 million acres of public lands. It is believed that losses of this size were common prior to 1940, for since 1890, 80 percent of Alaska's forest lands are estimated to have been burned over one or more times. Such huge losses cannot be afforded even by a state as large as Alaska or by a nation as wealthy as the United States.

Alaska's forests, both coastal and interior, are a great wealth and provide a basic resource for her industrial future. The southern coastal forests are largely contained within the Chugach and Tongass National Forests and because of high precipitation usually do not have too severe a fire problem.

The portion of Alaska north of the Coast Range and south of the Brooks Range in the Arctic has a semiarid, continental climate, and fires burn readily. This region is usually referred to as "western" or "interior" Alaska, and contains some 225 million acres of public domain lands requiring protection from fire. Of these lands, 125 million acres carry an estimated 350 billion board feet of spruce, birch, aspen, and cottonwood, and the average annual fire loss in wood fiber alone would support ten 350-ton-per-day pulp mills.

The rotation necessary for the sustained-yield requirement of a stable forest industry in Alaska is one hundred years or longer. Wild fire is a constant threat and must be minimized by the prosecution of an adequate fire control program. Alaska's forest future has already been threatened by overlong neglect and loss of growing stock.

Many severely burned forest areas have reverted to grassland and bare soil or rocks, and will require centuries, if unaided, to regain forest growth; however, most areas have relatively rapid regeneration.[1] Growth rates in young stands are often phenomenal and in general can be compared favorably to the better stands of the Lake States. Nature is prolific in the north and only a little assistance from man is needed to keep Alaska covered with a green mantle of vegetation.

Climatic Influences

A continental-size peninsula dominated by three east-west mountain systems, Alaska is bathed by 33,000 miles of tidewater and warmed on the south by the Japan Current which, due to prevailing southerly winds, has a moderating climatic influence over most of the state. The southern coasts have heavy precipitation and a moderate climate similar to Philadelphia; the interior of Alaska has a continental climate with cold winters, warm summers, and low precipitation. In fact, much of Alaska can be viewed as semiarid with only 4 to 20 inches of precipitation. The north coast is cool to cold the year around.

The far northern latitude has a marked effect on Alaska's summer weather, for the 20 to 24 hours of daily sunlight keep soil and fuel temperatures up, fuel moisture down, and evaporation rates high. The prevailing daily winds of 3 to 15 miles per hour create dangerous fire conditions. All that is needed is fuel.

Vegetative Fuel Types

Moss is the typical ground cover in the Boreal Zone of North America. It is found everywhere: as a 2- to 12-inch carpet under most forest stands; as muskeg and tundra types stretching to the treeless limits of vegetation in the Arctic; as an associate of grass and reeds in the often large, but typically narrow, belts of grass flats found intermingled with forests and brushlands (Fig. 1), and as a shallow carpet under the brush types of alder and willow. Moss does not occur on recently and severely burned areas, on steep southwest slopes, or under young aspen stands. But everywhere there is a mantle of either moss or grass which constitutes a flash fuel highly sensitive to the semiarid climate. Also typical of the Boreal Zone are dense spruce forests with tree length crowns and lower branches resting in the moss.

Alaska's green vegetation mantle, which is broken only in a few places by bare mountains, snowfields, or river bars, makes the fire problem. Its flash fuels foster easy ignition and rapid spread, and its millions of acres of spruce with low-hanging branches carry surface fires into the crown. The typical Alaska fire is a crown fire.

Couple this vegetation carpet

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[1]Lutz, H. J. Ecological effects of forest fires in the interior of Alaska. U. S. Dept. Agric. Tech. Bul. 1133. 121 pp. 1956.

with the semiarid climate (similar to the high desert of Arizona, Utah, and Nevada) and the condition that results is, to employ a term often used by the writer, "green desert." The "green desert" gets its moisture from subsurface sources rather than from the air. Melting permafrost is often the source of this moisture, but, from whatever source, it enables the vegetation to thrive. However, though the carpet is green, the semiarid climate makes it highly flammable at all times. The upper two inches of moss rapidly reflect air moisture conditions. At one moment the moss is brittle; the next, it absorbs sufficient moisture to resist burning.

FIG. 1.—The open grass flats and muskegs provide good heliports, if not too wet, for USAF H21. Each year Air Force and Army 'copters are used to transport fire crews from staging areas to fires, or point to point around fires. 'Copters make quick fire suppression possible; crew movement on foot averages about one mile per hour—a rate much slower than average rate of fire spread.

The Fire Season

The fire season in Alaska is four to six months long with peak severity throughout June and July. This peak roughly coincides with the lightning season—May 23 to August 5. Fires in April and May tend to be surface fires burning in winter-killed fuels. By late May, however, the frost has gone out of the ground, and hot, deep-burning ground fires are common. Burning in deep moss, they are difficult to extinguish, and often involve days and weeks of laborious digging to extinguish all fire. Failure to put out these fires has led to later season flare-ups, in some cases, carry-over of a fire from one fire season to the next. Moss fires are a part of all Alaskan fires.

The summer solstice brings the longest days, highest temperatures, driest weather, and most lightning of the year. Then fires start easily, spread rapidly, and may become roaring infernos which sweep across entire valleys and jump major rivers. Unchecked, they have attained sizes of 1.5 to 2 million acres.

Only in the far north of Alaska and Canada can such fires burn with so little effect on the general public. Natural resources that will be sorely needed within the next century are being lost, yet relatively little is needed to keep losses within reason now and in the future.

Past History of Fire

Fires are not new to the North. Except for pure spruce, the forest types are fire types, and under controlled conditions fire is a feasible management tool. Lightning fires have probably always occurred and there is evidence that early man through carelessness or through intent set many fires.[2] Fire really became a destructive element in Alaska's development and exploitation when the hordes of miners arrived in the late 1880's and followed the several gold strikes from the Yukon Territory to Nome.

Fires set by these miners or travelers were particularly injurious to timber stands because of their location in valley bottoms along the hundreds of rivers and streams. The good timber was there, along the routes of travel. Then when fires were started in the valley forests they often spread to the higher elevations covered by grass and brush.

Tree growth in Alaska is quite sensitive to relatively minor changes in temperature and moisture which in turn are strongly affected by relatively small changes in elevations. By their intensity and heat of passage fires have left behind them altered sites — sites which often will not again support timber for centuries. Such effects are particularly evident at timberline or on sites with similar climatic conditions. There is a delicate balance between life and death in the Arctic for both plant and animals.

Even with this history of numerous large fires there remains great forest wealth, but waste now and in the future cannot be as easily suffered as in the past for the population of man is doubling in fifty years and demands for wood products are increasing at an even greater rate. It is well to remember that a rotation in spruce will be at least one hundred years.

Organized Fire Control

During the late 1920's and early 1930's the public began to realize that the annual fire loss was a vital factor in Alaska's future economy. Miners were finding that fires destroyed watersheds thus depriving them of water needed to work placer claims. Trappers were losing trapping grounds and fur grades were dropping in the burned areas as compared to the unburned areas. Fishermen were finding streams polluted by excessive runoff and spawning beds were being destroyed. Smoke-filled air became an irritant to the resident and caused complaints from the tourist who was unable to enjoy the scenery he had traveled so far and at such cost to see.. The resulting attempt to remedy the situation was the passage by Congress of an act

[2]Lutz, H. J. Aboriginal man and white man as historical causes of fires in the boreal forest, with particular reference to Alaska. Yale University School of Forestry Bul. 65. 49 pp. 1959.

to establish the Alaskan Fire Control Service and an appropriation of $37,500 to set up an organization. The Alaskan Fire Control Service, under the former General Land Office, U. S. Department of the Interior, came into being on July 1, 1939.

During the 1940 fiscal year, the AFCS bought some equipment, hired a few people, and gathered information on the fire problem. (Strangely enough, the "old timers" claimed no knowledge of lightning-caused fires and so the writer stated in his first annual reports that all fires in Alaska were man-caused and could be prevented!)

In the spring of 1940 the fledgling AFCS began its first fire season. That was also the first year of World War II, of Lend-Lease commitments, and general tightening of peace-time activities and expenditures in preparation for war. As a "member of an old line agency" the AFCS received a cut in funds to $27,500 for its second year of operation!

The war years saw unprecedented activity in Alaska. The Alaska Highway was built. Many military installations were constructed. Air fields were laid out and air travel to the "states" was initiated. Thousands of construction workers and military personnel penetrated all parts of Alaska, but tourism as such came to a complete stop, as did mining and trapping activities.

Through it all the AFCS with the full assistance of the Alaskan Defense Command took action in every fire within its reach. Fire losses were reduced from 4.5 million acres in 1940 to 117,000 acres in 1945.

Cessation of war brought a quick resumption of civilian activities, without military control. Fire losses in 1946 and 1947 were 1.5 million acres each year. The Korean conflict and the general "cold war" have seen continued military emphasis, resulting in a constantly increasing population and more land settlement and development.

Other factors influencing the fire problem in Alaska are:

1. Since all western and interior Alaska is public domain, most developmental activities occur on the public lands. In a pioneer country land and resource development and settlement require land clearing. Disposal of debris is best done through use of fire. Carelessness or sudden weather changes may cause these fires to become wild fires. Such land clearing fires occur throughout Alaska, not only along the highways. The Bureau of Land Management, successor to the General Land Office, therefore, has a fire problem which will increase as the rate of development increases.

2. The vast size of Alaska makes early detection and quick suppression of fires difficult.

3. Highway access to the domain lands is limited (only 5,000 miles of roads in all Alaska), but the current 10-year federal highway program will place several hundred miles of road into the hundreds of thousands of square miles of untapped country. Since man's carelessness cannot be eliminated and he now starts 7 of every 10 fires in Alaska, fire incidence in these areas will certainly increase.

4. The size of Alaska and general remoteness of her forests and rangelands greatly aggravate problems in logistics, and require heavy reliance on aircraft operations. Only by the use of aircraft can the problems of remoteness, access, distance, and time be reduced to the capabilities of the small, highly mobile organization developed by the BLM. It is in these remote areas that most of the lightning fires occur. Lightning causes an average of 35 percent of the fire occurrences (64 percent in 1959).

5. Tourist and recreation travel to Alaska is increasing at the rate of 30 percent a year. These people penetrate all sections of the state and together with the hundreds of persons engaged in prospecting (e.g. oil and gas exploration) increase the likelihood of fire occurrence.

6. Increasing national and state interests in the protection of wildlife habitat and migratory fowl nesting grounds from fire, as well as the higher values now being placed on Alaska's forests as a re-

FIG. 2.—Loading fire equipment into BLM Goose at small airstrip being used as staging area. Several fires are serviced from such strips and equipment and supplies are brought from Anchorage or Fairbanks centers by chartered C-46's, F-27's.

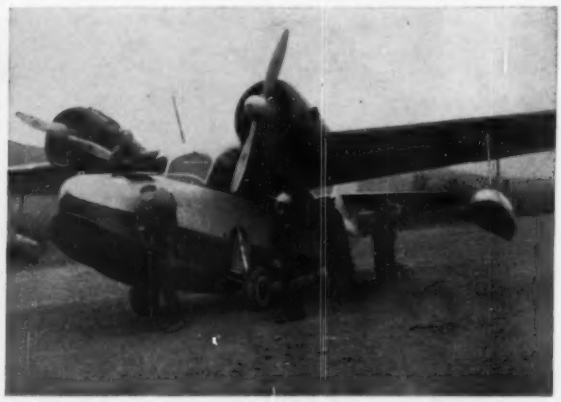

FIG. 3.—Standard aerial initial attack crew is six men. Crew loading equipment for trip to fire burning alongside a lake.

sult of wood pulp possibilities, make more effective fire control mandatory. The waste of resources which can be afforded by a pioneer economy become burdensome, and perhaps disastrous, losses to a more highly developed one. Thus the goal of BLM's fire control program is to reduce the annual loss to about 100,000 acres. This loss can be suffered without too serious depletion of the state's resource base, and can be currently held down at a pre-suppression cost of about one-half cent per acre. Of course, protection standards will change as Alaska develops.

Accomplishments

As annual funds increased from $37,500 in 1940 to $625,000 in the past two years, BLM developed a small, highly mobile fire organization with strong emphasis on aerial operations. There are currently 30 permanent and 25 seasonal personnel in the organization. While the aerial operations and techniques differ but little from those used on some fires in the western states, they are used on nearly all Alaska fires.

BLM has reduced average losses from nearly 5 million acres to 1.2 million acres a year. Formerly, only a small percentage of fires were within physical and economic reach of the organization; perforce, other fires were allowed to burn. Today, about three-fourths of the fires are controlled by BLM; the remainder are still beyond the ability of the organization to suppress. This situation usually comes about when a number of fires start on the same day (more than there are personnel to combat) and several must await action until earlier fires are controlled. This unavoidable delay in some instances allows fires to attain such large size as to make feasible suppression efforts impossible. Again, some of these delayed action fires are later extinguished by changes in weather before crews can be placed on them.

BLM has established two major operational bases at Anchorage and Fairbanks, the only two cities in interior Alaska able to provide manpower, food, equipment, supplies, and services needed to launch and support fire crews in the field. These two bases are under the immediate supervision of operations fire control officers and their staffs. Four local stations at McGrath, Big Delta, Palmer, and Homer serve as secondary bases with limited facilities, but higher than average fire problems. Nine additional fire guard stations located along the highway system are manned seasonally. The station at Fort Yukon is above the Arctic Circle and is the northernmost station on the continent.

"Portable" decentralized base operations can be established wherever several fires occur in the same general area. These serve as staging areas. Such operations reduce the amount of air travel time and allow for more rapid manning of

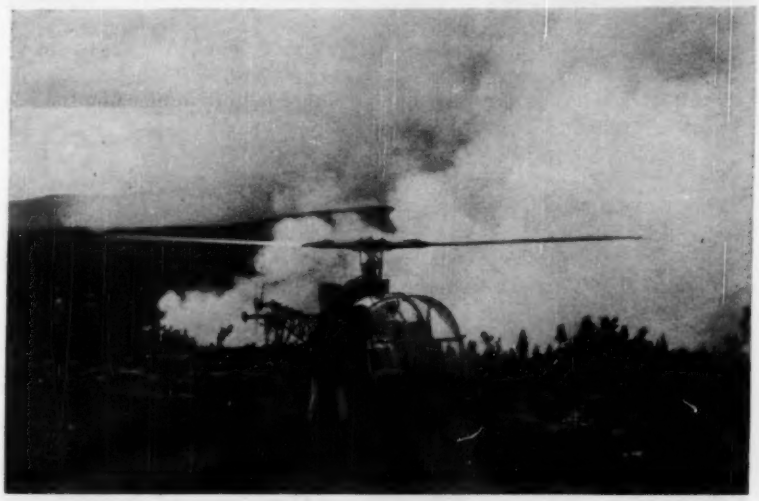

FIG. 4.—Alouette helicopter being used to spot crews around fire perimeter. Note typical tree line growth of scrub timber, mosses, lichens, and heath.

FIG. 5.—First smokejumper crew used in Alaska in 1959. Suited up and ready to go in the BLM DC3.

fires in the area. Temporary bases may remain in operation from 15 to 45 days.

BLM owns some aircraft—Grumman Gooses, Cessna 180's, and a DC3—and charters many more. Its own aircraft are used in detection, in dropping smokejumpers, in aerial delivery of equipment and supplies (Fig. 2), and in the delivery of fire crews (Fig. 3). Civilian aircraft are chartered for general crew movements to air fields, and helicopters (Fig. 4) are used for transport along the fire line, and for recovery of smokejumpers and others in isolated spots. The U. S. Air Force and U. S. Army have for years played an important role in Alaska fire control for they have furnished helicopters, transport aircraft, bulldozers, and other equipment needed to combat off-post fires when there was no civil equipment available.

FIG. 6.—Completely portable borate unit is here being operated. Mixers, storage tanks, pumps, hose, and the borate can be ferried from Fairbanks to decentralized base. More sustained attack action on fire can be maintained when hauling time is reduced; costs are also lower.

FIG. 7.—Crew of Eskimos being picked up on Kobuk River (North of Arctic Circle) for fire duty.

A small contingent of 16 smokejumpers (Fig. 5) was used for the first time in Alaska in 1959. Loft facilities were established for them in Fairbanks. Funds permitting, it is planned to increase this crew to 40 men by 1963. This rapid means of delivering fire fighters was the final step to a complete aerial operation. Smokejumper importance to Alaskan fire control was proven in 1959.

BLM has also actively fostered the use of aerial tankers for "bombing" fires with fire retardants such as sodium calcium borate, bentonite, and others. TBM's, F7F's, and B-25's have been used with considerable success. The tankers are used to hold a fire in check until ground crews or smokejumpers can arrive. Time is a definite factor in Alaska fire control; probably better indicated by stating that in 1959 only 18 percent of the fires occurred within 50 miles of the two major bases, and 25 percent were in excess of 250 miles distant. With the typical rapid spread, it is essential that immediate retardant action be taken if the fire is to be controlled quickly and cheaply by ground crews. Aerial tankers and smokejumpers in a 1-2-1 attack have proven most effective. The work of the jumpers is made easier, the job is done quicker, and the men do not need as long to recuperate before being dispatched to new fires.

All aircraft, vehicles, stations, and fire crews have radio contact with one another. Both HF-AM and VHF-FM equipment is used. The FM gear is now being acquired to handle air-to-ground communications. Radio operations in the Arctic regions are subject to many interruptions and fadeouts. Fires have been lost because action requests could not be promptly received. These are frustrations the personnel have learned to live with, and it is not unusual to see men

with expensive radio equipment at hand using signal panels to make their wants known. New equipment is being acquired to replace old military surplus gear which is now twenty years old.

A Typical Fire Action

The description of a typical fire action will better indicate the great importance of aircraft, as well as the importance of clear-thinking dispatchers and warehousemen for a forgotten item may require a 500-mile round trip to replace, and a fire can be lost because of it.

The pilot of a patrol plane discovers a fire and radios a report to the dispatcher with an estimate of fire size, feasibility of aerial tanker and smokejumper action, and need for ground crew follow-up. The dispatcher alerts aerial tanker crews and smokejumpers for immediate take-off and calls up a ground crew of perhaps 25 men. These men may be hired at the station, or a native crew living nearer to the fire area may be alerted by radio. The tankers hit the fire. Jumpers drop to the fire, and tankers make second drops as needed. The ground crew may leave Fairbanks in a chartered C-46 to the airport nearest the fire, from which a BLM Goose may shuttle men to a lake or river nearer the fire. The crew either walks or flys by helicopter to the fire line. Helicopters move ground crews in and smokejumpers out. BLM planes then make aerial drops of equipment and supplies. Until the fire is out supplies are dropped on 3-day schedules. Coordination of the several types of aircraft with varying cruising speeds and payloads so that men and supplies move smoothly to a fire 250 miles from base is an intriguing challenge.

Again, a series of fires may be reported in a specific region. The fire control officers may decide to establish a temporary, decentralized base of operations. If so, ground crews are ferried there for standby and later dispatch to fires; a jump ship and crews of smokejumpers may be sent, as well as a portable retardant unit (Fig. 6), and the usual stocks of equipment and supplies.

For years the BLM has been training and developing special attack crews of Eskimos and Indians. Resident in the remote areas of Alaska, these men are hard workers and comprise about a third of the fire crews hired in the past two years. The Eskimos have strong personal interest in retaining unburned range for their reindeer herds, and the wages provide welcome additional income to these people living on the fringe of civilization in the Arctic (Fig. 7).

A final, technical development is the adaption of the Model 8 Fire Danger Meter of the Forest Service Intermountain Region to Alaska use. The Northern Forest Fire Laboratory in Montana has worked closely with the Bureau of Land Management in the collection and analysis of fire weather data, and in developing usable meter interpretations. However, the Alaska fire problem differs sufficiently from that of the other states as to make a full research program necessary.

The Normal Organization

BLM has developed what it terms a "normal fire year organization." This is the number of men, in proper categories, needed to control the fires in a year of normal occurrence, frequency, and distribution of fires to reduce fire loss to a maximum of 100,000 acres. The number of men needed, the warehouse stock levels and tool distribution, the number of aircraft, stations, etc. are all predicated on this normal year.

For example, under current cost levels the normal fire year organization involved required an appropriation of $1,250,000. As the fire problem increases with a developing Alaska, the "normal year" requirements will also increase. Even so, the presuppression rate of one-half cent per acre is far less than the current rates in the other western states.

Alaska has the major reservoir of forest resources needed in the future by a rapidly expanding state and national economy. These stands of century-long rotation spruce and birch have been severely depleted by fire. With the population doubling in fifty years and pulp demands increasing even more rapidly, it is good business to take such immediate steps as are necessary to provide adequate protection of these timber stands from fire. It is indeed cheap insurance to provide the well-being of future generations. The many other benefits of adequate fire control—for example, reduced watershed damage, improved stream control, lessened damage to wildlife and waterfowl—make a total cost of 1.3 cents per acre more than justifiable.

The Bureau of Land Management believes that it can provide adequate protection from fire by maintaining and using the most modern aerial techniques and equipment, and a small, highly mobile, highly trained fire control organization.

Fire As An Ecological Factor in the Boreal Forest of Alaska

H. J. Lutz

THE BOREAL FOREST of Alaska represents the northwestern portion of a great transcontinental forest belt that extends through more than 110° longitude, from Newfoundland and the Labrador coast in Canada to the limits of tree growth on the Seward Peninsula in Alaska. The boreal or interior forest of Alaska is characterized by white spruce (*Picea glauca* [Moench] Voss) and black spruce (*P. mariana* [Mill.] B.S.P.). Tamarack (*Larix laricina* [Du Roi] K. Koch) is encountered only occasionally and is relatively unimportant. Although the forest is dominantly coniferous, several hardwood species are distributed throughout and locally may form extensive pure stands. These are Alaska paper birch (*Betula papyrifera* Marsh. var. *humilis* [Reg.] Fern. & Raup); Kenai birch (*B. papyrifera* Marsh. var. *kenaica* [W. H. Evans] *A.* Henry); quaking aspen (*Populus tremuloides* Michx.); and balsam poplar (*P. balsamifera* L.).

Prevalence of Fire in the Boreal Forest

All evidence known to the writer leads to the conclusion that fire has always been common in the forests of the Alaska interior. This evidence is both direct and presumptive. Direct evidence is found in the literature; in the charcoal present in practically all upland forest soils; and in old fire scars on trees and on the face of every landscape (*8, 9*). Presumptive evidence pointing to prevalence of fire in the boreal forest in prehistoric time is also strong. We know that both climatic conditions and the nature of the forest itself are highly favorable for the start and extensive spread of fire. Annual precipitation in the Yukon and Tanana River valleys, for example, averages around 10 to 13 inches; at Fort Yukon the average is only 6.54 inches. With the prolonged hours of daylight and possible sunshine characteristic of summer in high latitudes, the weather often becomes warm, and even hot. Maximum temperatures between 90 and 100 degrees Fahrenheit are registered almost every summer. Atmospheric humidity is often low and lightning is common.

The boreal forest is, by its very nature, highly flammable. The conifer trees are often comparatively small and frequently support a more or less heavy growth of so-called mane and beard lichens (Alectoria and Usnea species). Fire carries readily in dense stands as it also does in open ones; in the latter the trees often retain their branches to the ground and the intervening openings support a cover of mosses, lichens and small shrubs. In summer the mosses and lichens become very dry and then possess a tinderlike quality. The thick forest floor of peaty material serves to carry fire and may even burn slowly under winter snow cover from one season to another.

It is highly probable that fires, caused by lightning, were a part of the environment of the boreal forest long before the advent of earliest man. Well-preserved tamarack wood found in Pleistocene deposits at Toronto, Canada . . . "showed the effect of fire, indicating the result of a forest fire" (*10*). Charred wood and charcoal fragments are also known to occur in the frozen Quaternary deposits of central Alaska. This material occurs in sediments older than 5,000 years so is regarded as resulting from forest fires and not associated with human activity.

Effects of Fire on the Vegetation

At first view the vegetation cover of any extensive landscape in the interior of Alaska is likely to impress one as a patchwork or a haphazard mosaic. However, on closer inspection and with greater familiarity, it becomes evident that elements of regularity are also present. The complexity of the vegetation pattern cannot be explained on the basis of the factors of the physical environment alone, important as they are. Only when the effects of fire are appreciated can one begin to understand the contemporary forest and other vegetation communities. It should be recognized that this powerful ecological factor has operated as long as the boreal forest has existed. Uggla (*14*), writing of conditions in Norrland, observed that "Fire has always been a very important factor in determining the extent and composition of the boreal forests." Sharp boundaries between forest stands of differing species composition or age class usually represent the edges of burns; this is especially true of boundaries that cross contour lines irregularly. Isolated stands of small size, upland stringers, and scattered trees often represent relicts of former, more extensive, stands destroyed by fire. Occasional treeless

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areas, now bearing a cover of grasses (chiefly *Calamagrostis canadensis* [Michx.] Beauv.) and fireweed (mostly *Epilobium angustifolium* L.) were reduced to their present condition by repeated burning.

All tree species in the boreal forest are killed by severe fires; none have bark sufficiently thick and of a character to withstand the high temperatures that are generated by intense fires, especially around the basal portions of the boles. This is confirmed by the fact that in areas swept by severe fires practically all trees are killed and that living trees with fire scars are uncommon. Only rarely are living fire-scarred trees encountered and they are usually located at the edges of burns where intensity of fire was low (Fig. 1). Another reason for the very heavy mortality caused by fires is the characteristically shallow nature of the tree roots. Part or all of the roots of white and black spruce trees often occur in the unincorporated organic matter resting as a blanket on the mineral soil. Slowly burning ground fires may burn off living roots as large as 8 to 9 inches in diameter.

White spruce.—This is the most common species in the boreal forest and is largely responsible for the vegetational aspect of the landscape (Fig. 2). It frequently forms pure stands but also occurs mixed with Alaska paper birch and Kenai birch, quaking aspen, or balsam poplar. Quite commonly white spruce appears as an understory in the hardwood stands. Under white spruce the minimum depth to permafrost (if it is present at all) is generally 24 to 36 inches. White spruce may attain a maximum age of 500 years, or more, being longer lived than any of its associates. It may appear as a pioneer on burned areas but is generally regarded as more characteristic of communities representing late stages of successional development.

Single light surface fires in white spruce past the pole stage do not result in complete destruction of the stand. Rather, small openings are created and in these seedlings of spruce, birch, and quaking aspen may appear. The openings often result from intense local burning in the mounds of cone scales 1 to 2 feet deep and 10 to 12 feet in diameter that occur around the bases of occasional spruce trees. These mounds represent feeding stations of red squirrels (*Tamiasciurus hudsonicus*) which are common animals in the boreal forest. Changes in forest composition usually are small; under conditions of partial shade, seedlings of white spruce stand a better chance of surviving and developing than do birch and quaking aspen. In stands of reproduction and trees not yet past the pole stage even light fires are very destructive, owing to the thin, easily damaged bark of the young spruce. Mortality is heavy and change of composition often results from the lack of spruce seed.

Severe fires generally bring about complete destruction of the existing forest; the composition of the new stand is primarily dependent upon the seed source available (Fig. 3). Hesselman (*4*) pointed out that in Sweden warm summers and abundant seed production in Norway spruce often occur together and noted that forest fires are unusually common during warm summers. It appears to the writer that in the boreal forest of Alaska there may be a similar tendency toward coincidence of good seed years and years of extensive fires. Optimum seed-bed conditions for all species in the boreal forest are similar, consisting of mineral soil. If the burn is extensive and all white spruce seed trees are destroyed, reproduction will consist largely of quaking aspen, birch or occasionally, balsam poplar. Seed of these species is small and widely disseminated by wind. Relatively small burns with adjacent living seed trees may reproduce to essentially pure white spruce. Compared with its associates, white spruce is often at a disadvantage in seeding burned areas. It does not bear seed in quantity until 50 or more years of age which is about two or three times as long as for seed production by birch, quaking aspen, or black spruce. Further, the seed of white spruce is larger (240,000 to 400,000 seeds per

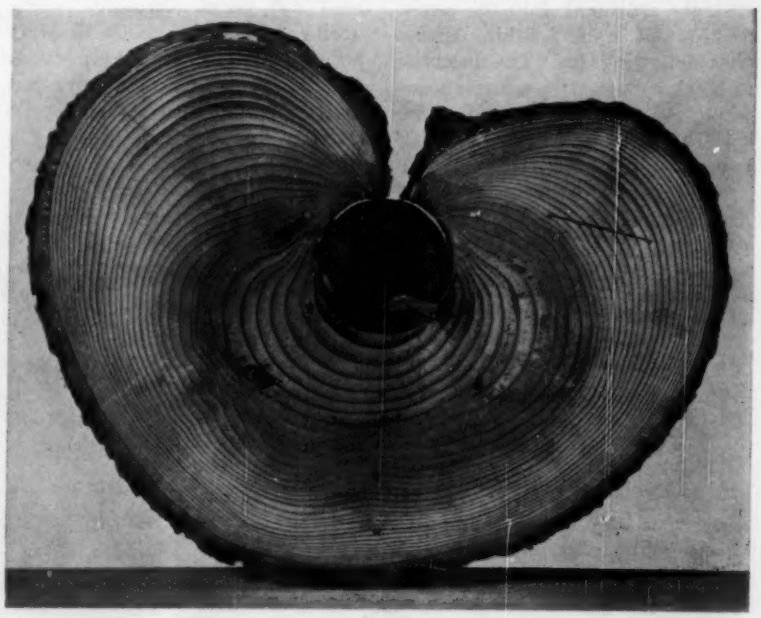

FIG. 1.—Showing rapid growth of a fire-scarred white spruce located at the edge of a burn. The tree was 17 years old at the time of the fire, and 54 years old and 6.5 inches in diameter when cut. Scale in upper right is 1 inch. Downward retreat of the permafrost table following the fire accounts for the increased growth. Copper River valley, Alaska.

FIG. 2.—Rather open stand of white spruce 140-150 years old; dominants 12-18 inches in diameter. The shrubby growth consists of willows and dwarf birch (*Betula glandulosa* Michx.). Upper Matanuska River valley, Alaska.

pound) than birch (1,380,000 to 4,120,000), quaking aspen (3,670,000 to 7,550,000), or black spruce (404,000 to 510,000), and is less widely disseminated. Unlike black spruce, the seed of white spruce is disseminated fairly rapidly after cone opening; there is no retention of seed in unopened cones as in black spruce. Black spruce may be strongly represented in the reproduction on upland white spruce sites following fire. The behavior of black spruce after a fire is somewhat analogous to that of "fire species" such as jack pine and lodgepole pine.

As a result of repeated severe fires, some areas, formerly occupied by white spruce, have become essentially treeless, now supporting only herbaceous or shrub communities. This replacement has most often occurred at the upper altitudinal or latitudinal limits of forest growth. Natural reconversion of these presently treeless communities is exceedingly slow, evidently a matter of hundreds of years.

Black spruce. — This species is characteristically a tree of cold, poorly drained situations, in relatively flat valley bottoms, on flat to gently sloping land with a gradient of less than 10 percent, and on north-facing slopes. Areas bearing black spruce growing in cold, wet, peat soils with permafrost not more than 12 to 20 inches below the top of the moss and lichen layer are designated as black spruce muskeg. These stands are usually pure, composed of small very slowly growing trees. On relatively well-drained upland areas, with deeper permafrost, black spruce of better growth may also occur in pure stands but more generally is found in mixture with white spruce, birch, or quaking aspen. Black spruce ranks next to white spruce in regard to maximum age attained, reaching at least 250 years. On cold, poorly drained soils with shallow depth to permafrost, black spruce represents a self-perpetuating community that may be designated as a physiographic climax. Reproduction is by both layering and seed. On well-drained upland areas to which black spruce has spread under the influence of fires the species is regarded as temporary.

Fires in black spruce are often intense, completely killing the stand and consuming the forest-floor material (Fig. 4). Crown fires are favored by the relatively low stature of the trees, the presence of tinder-like mane and beard lichens that festoon the branches, and the common but not invariable high stand density. Black spruce usually regenerates itself following fires, and stand composition is not greatly changed. The species bears seed at younger ages than does white spruce and crops are more regular. Cones are semiserotinous, retaining part of their seed for several years; as a result of this habit a supply of seed, stored on the trees, is continually present in stands that have arrived at the seed-bearing stage (Fig. 5). The small seed is disseminated to considerably greater distances than is the seed of white spruce. During crown fires that kill black spruce much if not most of the seed stored in the more or less isolated clusters of cones in the upper portion of the crowns remains undamaged. Following a fire the cones open, discharging their seed on the seedbed of ashes and charred organic material or mineral soil. Extensive dense, pure, even-aged stands of black spruce frequently result.

Repeated fires at intervals shorter than 20 to 30 years (that is, seed-bearing age for black spruce) may result in replacement of the

FIG. 3.—View in a severely burned stand of white spruce one month after the fire. Organic matter was completely consumed around the tree stumps. The stand was about 155 years old, with dominants around 12 inches in diameter. Delta River valley, Alaska.

FIG. 4.—View taken 3 years after a severe fire in a 110-year-old black spruce stand. The largest spruce trees are 4-5 inches in diameter. Herbaceous growth is fireweed, about 18 inches tall. Kenai Peninsula, Alaska.

species by treeless communities of sedges, rushes, grasses and low shrubs. These communities may persist indefinitely because of lack of spruce seed and the difficulty of tree seedling establishment.

Alaska paper birch and Kenai birch. — Ecological differences between the two principal tree birches in the boreal forest of Alaska are not perceptible to the writer, so the two species are considered together. Birch is of widespread occurrence on the upland areas where the minimum depth to permafrost (if it is present at all) is generally 36 to 48 inches. Pure stands are common and the species also occurs mixed with white spruce; association with quaking aspen or black spruce is less frequent. Birch stands with white spruce as an understory are often encountered. Most young birch stands are even-aged but in the course of their development to maturity tend to become uneven-aged. With respect to longevity birch occupies a position intermediate between the relatively long-lived spruces and the short-lived quaking aspen.

When occurring in essentially pure stands, birch is a fire type. Barring disturbances such as fire, white spruce gradually enters birch communities and in the course of time converts them to white spruce-birch. Fires tend to perpetuate birch and discriminate against spruce. Following fires there is usually some sprouting of birch stumps but the principal reason for the decline in the proportion of spruce is lack of seed. The number of spruce trees that bear seed in birch stands is low because most of them are in the understory and only a few have their tops in a position to receive direct sunlight. Under these conditions white spruce regeneration can come only from seed blown in from adjacent unburned stands. Seed production by birch begins at the relatively early age of 20 to 30 years and crops occur with fair regularity. The small seed is readily disseminated by wind and the exposed mineral soil in burned areas forms a favorable seed bed for germination and juvenile development. Excellent dense stands of well-formed trees often result (Fig. 6). Kujala (*6*) reported that in Finland birch (*Betula alba*) trees burned sufficiently to kill the cambium completely around the base, still retained a mantle of foliage and yielded an excess of ripe seed, except on the lowest branches. It is not known whether the birches in Alaska possess this same characteristic but if they do it must have an important influence on reproduction following fires.

Quaking aspen. — This species commonly forms extensive stands on upland areas, especially the drier situations on south-facing slopes. Under quaking aspen the minimum depth to permafrost (if it is present at all) is generally at least 4 feet. Pure stands are common but white spruce, birch, and balsam poplar may appear in mixture. Of the associates of quaking aspen, white spruce is the most important. It may start with the aspen immediately after a fire, or gradually enter the stand later (Fig. 7). In either case the natural course of development is for the spruce to dominate and finally replace the aspen which is shorter lived and less tolerant than any of its associates.

In pure stands quaking aspen is a temporary fire type; the only exception seems to be steep, excessively dry south slopes where the species appears to be able to persist indefinitely. Fires perpetuate aspen and destroy most of the white spruce and birch that may have

FIG. 5.—Black spruce 4-8 inches in diameter with large cone clusters. The semiserotinous cones play an important role in regeneration following fires. Chatanika River valley, Alaska.

FIG. 6.—Dense stand of Alaska paper birch, with dominants 4-6 inches in diameter. This stand followed a fire in white spruce 30 years ago. Chatanika River valley, Alaska.

FIG. 7.—Quaking aspen with understory white and black spruce that developed following a fire 55 years ago. Dominants are 6-7 inches in diameter. Kenai Peninsula, Alaska.

been present in the stand. Of all the trees in the forests of the Alaska interior, quaking aspen is the most prolific sprouter after fires. Vigorous sprouts arise in tremendous numbers from the roots of fire-killed trees and practically assure that areas supporting aspen before a fire will be regenerated with the same species by root suckers alone. Seedling reproduction on burns is also abundant. Seed is borne at an early age, is very widely disseminated, and mineral soil exposed to full sunlight provides favorable conditions for germination and seedling development. As Strothmann and Zasada (*12*) remark, "Much of aspen's life history is bound up with fire."

Balsam poplar.—This tree occurs most commonly in essentially pure stands on recently deposited alluvium along streams and river valleys subject to overflow. It may also appear on upland areas, usually as a minor component in stands of quaking aspen, birch, or white spruce. Balsam poplar seems to be more sensitive to permafrost than any other species in the boreal forest; where poplar occurs the permafrost is either absent or at least 3 to 6 feet below the surface. The tree is probably longer lived than either birch or quaking aspen but does not attain the ages reached by the spruces.

Many of the balsam poplar stands growing on alluvium along the larger rivers represent the first forest stage in a primary successional series. Following fires it may also move onto upland areas adjacent to large streams. It appears that balsam poplar may occupy flood-plain areas indefinitely if they are subject to periodic overflow with deposition of sand, silt and other alluvium. On sites not subject to flooding, white spruce gradually assumes dominance, replacing the poplar. Fires are not as common in the balsam poplar type as in other forest communities, nor are they generally as severe. The species is probably more resistant to destruction by fire than any of its associates, mature trees often having bark 4 or more inches thick near the base of the bole. Nevertheless, heavy mortality from fire often does occur and then reproduction by root suckers and seedlings follows just as in quaking aspen. There are many similarities between the ecological characteristics of the two species.

Effects of Fire on the Soil

In general, the soils of the boreal forest in Alaska are shallow both in terms of the action of soil-forming processes and in a physiological sense; many of them are young. Under forest stands, especially those with a deep forest floor, soil temperatures are low. These low temperatures retard chemical weathering of the soil material, reduce activity of soil organisms, and unfavorably affect physiological functioning of roots.

From the standpoint of mechanical composition, many of the soils have relatively little clay. The upper layers usually contain a high proportion of very fine sand and silt, fractions that are believed to have been brought in by wind. The surface mineral soil is often fluffy when dry, cohesion is weak, and aggregates, if present, tend to be small and weak. Internal drainage in most fine-textured soils is slow to poor. Permafrost at relatively shallow depths commonly produces, in effect, a perched water table. Some soils have developed over coarse gravelly or cobbly outwash; these may be so excessively drained that quaking aspen and balsam poplar defoliate because of water shortage during periods of summer drought.

The organic matter tends to be unincorporated with the mineral soil, resting on it as a mantle. Thickness of the forest floor material varies from 2 to 4 inches in birch, quaking aspen, and balsam poplar stands to 4 to 6 inches, or more, in spruce forests. Under old white spruce and especially in black spruce, the layers of organic matter may be 12 or more inches thick. Humus-layer conditions under birch and quaking aspen seem generally more favorable than under spruce. Uggla (*15*), who studied fire effects in Lapland, just north of the Arctic Circle, stated that "The fire has an indirectly favourable influence also in the long run by favouring the entry of birch and aspen as pioneer trees into the burnt area. The leaves contribute every year a new quantity of litter to the soil, the temperature of which rises below the leafless trees in the spring." The general lack of incorporation of organic matter into the mineral soil appears to result from the scarcity of soil animals such as earthworms and large arthropods.

Permafrost, or frozen ground, is a common feature in soils of the Alaska interior. Depth below the surface varies with drainage conditions, topographic exposure and degree of slope, vegetation type and thickness of the forest floor.

Depending on their intensity and frequence, fires remove humus layers wholly or in part. Complete destruction most commonly occurs on well-drained rocky slopes or ridges where both fuel and atmospheric conditions favor intense burning. Burning is also very intense, with exposure of mineral soil, around the bases of spruce trees where a dry forest floor and the accumula-

tion of cone scales and other highly inflammable debris are added factors favoring hot fires. Burning to mineral soil generally involves about 30 to 40 percent of the ground surface.

Soil acidity is invariably reduced by fires (*1, 5,* and many others). Where the humus layers have been consumed and mineral soil exposed, pH values of 6.5 to 7.5 are common. This shift from a strongly acid to weakly acid, or even alkaline, condition has been reported by many investigators and is generally regarded as ecologically favorable in boreal forest soils.

Nitrogen contained in the organic matter that is consumed is, of course, volatilized and lost. In spite of the loss of nitrogen in organic matter destroyed, nearly all evidence from northern forest regions points to an increased availability of nitrogen to vegetation following fires. One of the most common and characteristic plants that comes in on burned areas is fireweed, a species generally regarded as nitrophilous (*2, 4,* and many others). Uggla (*15*) suggested that a study of the quantitative development of fireweed on burns "... gives a good idea of the nitrogen conditions in the soil." Hesselman (*2, 3*) and others have shown that nitrification is usually induced in mor humus layers by burning. Tamm (*13*) in his treatment of northern coniferous forest soils, expressed the view that "There is not much room for doubting the fact that the improved 'soil climate,' so to speak, which results from a forest fire, is an active agent in the markedly increased activity in the mor covering." Even total nitrogen may increase to levels higher than existed before burning. This may result from development of wild legumes with nodules containing symbiotic nitrogen-fixing Rhizobium organisms or it may result from increased activity of free-living, non-symbiotic nitrogen-fixing bacteria.

Readily available phosphorus, and exchangeable calcium and potassium may all increase several fold as a result of burning. The tendency for increase in these elements following fires in the boreal forest seems to be almost universal. Fires, of course, merely liberate the mineral elements contained in the humus layers; they create nothing new. A fire makes quickly available materials that previously existed in the humus in forms only slowly available, or unavailable, to higher plants. European foresters have regarded the nutrient capital in thick raw-humus layers as a figurative frozen asset; in the interior of Alaska it may literally be a frozen asset.

Following fires, surface temperatures of the mineral soil increase because of the elimination or reduction of the unincorporated organic matter and the frequently darker color of the surface, caused by charcoal. The increase in soil temperature is reflected in an almost invariable downward retreat of the permafrost table (*11*).

Soil texture and structure are not appreciably altered by fires. For texture to be changed there would necessarily be either fusion or baking of mineral particles into larger units or a breakdown into smaller units. Only rarely does this occur. In most undisturbed mineral soils aggregate development is slight because of the low content of organic and inorganic colloids; burning seems to have little effect on soil aggregates.

Complete destruction of the forest floor on steep slopes, particularly those with southerly exposures, increases surface runoff and consequently reduces the amount of soil water available to plants. Increased evaporation works in the same direction. Reestablishment of forest growth on such sites is a slow process. On land with gentle topography and on flat areas, soil moisture relations do not appear to be altered unfavorably by fires. Actually such alteration of water relations as results from downward retreat of the permafrost table may be favorable, increasing the volume of mineral soil available to root development. The field capacity of the mineral soil layers, as judged by moisture equivalent values, shows little if any change.

In many areas of interior Alaska the frozen ground contains bodies of ice in the form of lenses, wedges or blocks. When the natural vegetation and forest floor are removed by fires or other agents the ice begins to melt and settling and caving produce an unstable, pitted surface, sometimes called thermokarst.

In a northern region such as that of the boreal forest, fire often has a favorable effect on soil properties. The deep forest floor that characteristically develops under old spruce stands does not contain the rich store of available nutrients that one ordinarily associates with the term humus. During summer the thick layers of unincorporated organic matter, together with the accompanying heavy growth of mosses and lichens, become dry and in this condition possess remarkable capacity to insulate the mineral soil against entering heat. From the standpoint of forest growth such layers are better viewed as an encumbrance on the site rather than as a beneficent mantle that "protects" the mineral soil.

Fire As A Future Management Tool

In view of the widespread destruction that wildfires have wrought in the boreal forest and the tremendous problems involved in their control it may seem preposterous to even mention the possibility of using fire as a management tool. Although the subject is understandably a delicate one it is believed that the possibility of beneficial use of fire does exist and that it should be explored. In an earlier discussion of forest fires in the Alaska interior the writer observed that: "Fires have, in numerous instances, resulted in the establishment of rapidly growing, healthy forest stands of desired tree species. Silviculturists in some regions have already learned how to use fire as a tool to achieve their objectives. The gradual recognition among foresters of the useful role that prescribed burning may play

in forest management has been accompanied by increased attention to protection against accidental wildfires. The relationship between fire and game management is in many respects analogous to that of fire and forest management. In both fields fire may be used as a tool to favor establishment of new vegetation, to influence or control species composition, and for various other purposes. But neither in forest management nor in wildlife management can uncontrolled fires be justified. The ultimate place of prescribed burning in Alaska cannot now be stated. Neither the forester nor the wildlife specialist in Alaska today has the requisite knowledge to enable him to use prescribed burning on anything more than a purely experimental basis. There is great opportunity and need for research on this problem" (*8*).

The extent to which metallic cations such as calcium and potassium may be leached from the ash and lost is a matter that should be examined. In regions of low precipitation and permafrost, loss of nutrient elements by leaching may be slight.

Information is needed on the intensity of burn that creates conditions most favorable for reproduction of the different tree species. It appears that in the Scandinavian countries the aim in burning is not removal of the F and H layers. In most parts of interior Alaska, however, the writer observed better reproduction on areas where the burning was deep than where it was superficial.

The possibility of manipulating the position of the permafrost table through the use of fire seems worthy of consideration, at least on an experimental basis.

Even if the conclusion is reached that controlled burning affords benefits in forest and wildlife management not otherwise attainable there remains the very great practical problem of how to conduct such burning safely and at a tolerable cost. However, in other regions, including the boreal forest of north Europe, the techniques of controlled burning as a management tool have been worked out and successfully applied. Uggla (*15*) observed that "During the present century, fire has been used to an increasing extent in the service of silviculture, especially in the northern parts of Sweden. Controlled burning is practiced on raw humus grounds, mainly at high levels. It is now generally agreed that a properly conducted, controlled burning of the ground that is not too dry is the most efficient method of activating the humus, and of reducing the labour difficulties in planting and sowing on such land." The attitude of the present writer has been well expressed by LeBarron (*7*): "We must find ways to prevent the wastefulness of wild fires, yet utilize the forces for good which fire possesses."

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The Forest-Wildlife Resources of Alaska

Urban C. Nelson

IMPRESSIONS and knowledge of Alaska forests and wildlife have been largely gained through use of aircraft as contrasted to the early ground reconnaissance, survey, and inventory conducted in the other states. The aerial view gives one the impression that Alaska is a continuum of edge. If, in the nineteenth century, foresters could have flown over the cypress of Florida, the oak of Ohio, the white pine of Wisconsin, the redwoods of California, or even the fir of Washington they might well have been more impressed with the gross area of transitional forest than the true forest type described by current silvical standards. Not only are our generalized concepts of Alaska forests obtained from aerial observation but the detailed forest type and volume estimates of southeastern Alaska are derived from aerial photo interpretation based on a minimum of ground-collected data.

Every forester must at some time have wished to see the Arctic timber line. The line of spruce advancement which stretches across 700 miles of the south slope of the Brooks Range is easily defined, but the reason for its termination is less apparent. Yet, beyond the tree line along the Arctic Coast rivers, there are forests of willow and alder whose poles and branches furnish food and cover for moose, the frames for caribou hide huts or walrus hide boats of the Eskimo. The irregular tree line stretches for 1,000 miles in western Alaska, but beyond this forester's forest of the central river valleys are the willow, alder and cottonwood of the deltas where the beaver does its logging and the Eskimo cuts his wood for fuel or smoking salmon. The line of the westward advancement of Sitka spruce across Kodiak Island and the Alaska Peninsula is in its present location because time has not been sufficient for further advancement. The timber line of the coastal rain forest is some 2,500 miles long at an elevation of 1,800 to 3,000 feet. In each case the "line" is an arbitrary tool of definition. Forest advancement is approaching equilibrium between species ability to seed and grow and the barriers of rock, soil, ice, or snow.

Above and beyond the timber line the brown or black bear digs for roots, the black-tailed deer seeks light and lettuce, the marten scrambles for berries. The forest wildlife of Alaska is truly more a product of the edge, transition types, forest line, and timber line than of specific forest types. The continuum concept confuses the association of a given species of wildlife with a given forest type. The discourse following will show that the ranges of various species of wildlife are neither distinct nor constant by forest type.

Coastal Spruce-Hemlock Forest

The Sitka black-tailed deer, brown bear, black bear, mountain goat, beaver, wolf, marten, mink, and otter are important game and fur mammals of the coastal forest.

Deer, few by Colorado or Pennsylvania standards, vary from 50,000 to 200,000 in number. The annual sustained harvest of some 10,000 could be doubled with sufficient hunting pressure. The population controls are suggested in depth of snow and available forage at salt water levels. Ironically, the mature forest has less snow accumulation and less browse while the open areas of good browse are denied use by deer because of deep snow, a fact to be reckoned with by those who predict deer increases following logging of the climax forest. Protagonists of predator control cannot explain the similarity of deer numbers on wolf-free islands (Chichagof, Baranof, Admiralty, Hinchinbrook, and Hawkins) and the islands south of Frederick Sound which have wolves and black bear but no brown bear. Nor do biologists postulate conclusively on the ranges of brown and black bear which do not overlap on the islands of southeastern Alaska. Brown bear occur on the southern mainland coast and larger islands, their numbers and size related to fish and berry crops and escape cover or terrain. Brown bear will conflict with commercial forest use, and their numbers, if not actually threatened, will be held at present levels by rifles in the hands of the indiscriminate, fearful, or prejudiced. Black bear are found south of the tree line over most of Alaska except in the low, coastal areas between Kotzebue Sound and Bristol Bay. Their greatest abundance is associated with the interior valleys, where the forest, tundra, and heath edge furnish the various foods for their omnivorous demands. The few moose found along the coast are in the larger river deltas where a combination of cot-

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tonwood-willow forage, access through the coast range, and micro climates created by air drainage, provide the essentials for this excellent game animal. Here, too, the muskrat, ruffed grouse, and snowshoe hare have extended their interior range to coastal sites.

The early ecological stages of hardwood growth following glacial recession provide small areas of potential moose range along the coast, but physical barriers of rock and ice have prevented adoption by moose. Artificial stocking of moose on the Copper River flats under a Federal Aid in Wildlife Restoration project has been successful, and a similar attempt at Berners Bay is under way. The moraines of the vast ice fields along the coast between Cordova and Yakutat will some day furnish potential moose range during the period of transition to climax spruce and hemlock.

Above the timber line of the coast range east of Cook Inlet, mountain goats are common in the rough terrain. Their numbers show little fluctuation, the result of a biological potential barely equal to the mortality factors of a starvation range, snow and rock slides, deep snows, and perhaps predation. The long days of May in the dense forest resound with the accelerando hoot of the blue grouse. Rock and willow ptarmigan, as elsewhere over most of Alaska, frequent the area above the timber line. Mink, otter, and waterfowl are seen on the beach, creeks, and rivers. A few beaver colonies are on the rivers. Wolves, but few foxes and coyotes, hunt throughout the forest. In summary, only the deer, marten, red squirrel, and blue grouse are typical of the coastal rain forest and even here there are exceptions and voids yet unexplained by the forester or biologist.

Interior Birch-Aspen, Black, and White Spruce Forests

These forests are treated as a complex, not as a type, for wildlife is prone to occupy the edges of forest, heath, tundra, grass, or water areas. A general observation leads one to conclude that the wildlife of the boreal forests in the more northerly latitudes is less forest type-specific than in southern latitudes. Thus, the larger ungulates and carnivores, such as moose, caribou, grizzly bear, black bear, wolves, coyotes, and lynx are observed in all interior forest types and complexes. While some seasonal climatic or food factors are apparent, other patterns of wildlife occurrence or movements are erratic and unexplained. Territorial limits are more apparent for beaver, otter, mink, weasel, marten, muskrat, grouse, squirrel, and snowshoe hare, all of which are found in the forests of the interior. Spruce grouse and red squirrel are exceptions whose ranges are closely associated with the black and white spruce stands. The westernmost extension of the ruffed and sharp-tailed grouse range on the continent reaches to the upper basin of the Kuskokwim River. Strangely enough, the ruffed grouse is not found south of the Alaska range, a problem for the climographers.

The grizzly and black bear occur over most of the interior forests, associated valleys, and tundra mountain slopes. Nowhere are the grizzlies abundant and their status is less secure than any other game animal. Black bear are very common, and in early fall are seen feeding on ripening berries above timber line.

Within the United States, polar bear, walrus, and Dall sheep are unique to Alaska, but only the latter is associated with the forest. Sheep visit scattered stands of aspen, birch, and willow at higher elevations, although they normally confine themselves to the grassy slopes near rough terrain.

Moose are found in greatest abundance in the Cook Inlet drainages with populations of some 10,000 to 20,000 in the lower Susitna-Matanuska drainages, and over 5,000 on the Kenai Peninsula. Here the moose are associated with the birch-aspen forests. Choice wintering grounds at lower elevations are the younger age stands occurring in river valleys, old beaver flowages, burned areas, and cutover lands. During winters of severe

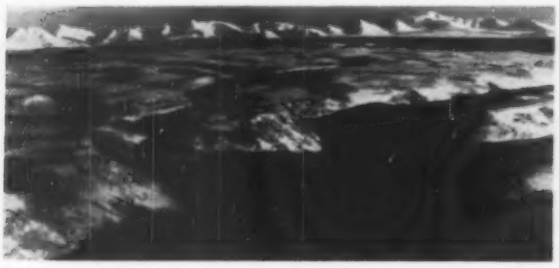

FIG. 1.—The open spruce and aspen bench land on the Kenai National Moose Range is a concentration area for moose during the fall season.

FWS photo by Spencer

FIG. 2.—Fox River on the Kenai National Moose Range. The willow and cottonwood of the flood plains and the birch-aspen on the adjacent lands provide a good combination of browse for the winter range of moose.

FWS photo by Spencer

snow the animals move to the lower valleys where conflicts with man occur along the Alaska railroad, highways, school and residential areas. Biological studies during the past decade have greatly enhanced the knowledge of the Alaskan moose. Aerial surveys have been extensive, and techniques for determination of numbers, sex-age ratios, distribution, and productivity have given reliable results on which to manage the moose. The Kenai National Moose Range is a 2,000,000-acre area dedicated to the management of moose, on which the Bureau of Sport Fisheries and Wildlife is essentially managing a forest for wildlife. The task becomes one of silvicultural manipulations to retard the succession from birch-aspen to climax spruce stands, and to convert mature forests of both types into young hardwood growth essential for maximum production of browse. Mechanical, chemical, and controlled burning experiments are under way.

Moose occur on the Alaska Peninsula, interior valleys, and on the Arctic Coast in numbers approaching 10,000. During this century the moose has advanced its range westward along the Yukon River and southwest on the Alaska Peninsula. This may be the result of reduced trapping and less use of dog teams by natives who formerly traveled more extensively. Moose were easily seen and approached in the low forest cover and deep snow. Stricter enforcement of the game law is perhaps one reason for moose on formerly unoccupied ranges.

The largest and most spectacular trophies are taken on the Kenai Peninsula and the drainages into Cook Inlet. The inaccessible bench land on the Kenai National Moose Range is a veritable "pasture" in September. One of the most spectacular sights on the American continent is a concentration of large bull moose in the varicolor of frosted foliage, antlers flashing among the black iridescence of fat, sleek animals.

Caribou, in number approaching half a million, range over most of interior Alaska. Except for the Arctic Slope herds, the caribou are generally associated with the complex pattern of tundra and spruce forests. Feeding on open knolls in summer and sedge-grass meadows in winter, these are not animals of the true forest. Their range is more closely associated with lichens, both ground and tree forms. Willow, grasses, lichens, and sedges are the most frequently reported foods.

Caribou are continuously on the move. This nervous activity has been explained by biologists as a search for preferred lichens, an escape from warble flies, a means for keeping their nostrils to the wind, and other less apparent rea-

FIG. 3.—Small tundra ponds melt first on the Colville River Delta along the Arctic Coast, enabling such plants to blossom as the marsh marigold shown on the pond periphery. Willows are in the foreground. Note ice on larger ponds in background.

FWS photo by Nelson

FIG. 4.—Caribou on the Alaska plains. Nearly one-half million caribou range from the interior Alaska forests and mountains to the coastal plains.

FWS photo by Chatelain

sons. Perhaps gregarious animals merely appear to be more alert and on the move than animals which live solitary lives. Of concern here is that if the caribou is dependent upon the forest, the clues are obscured by the wandering of the animal. Herds of approximately 40,000 caribou each occur in the Upper Susitna-Copper River drainages and in the mountains between the Tanana and Yukon Rivers. These herds range through the spruce, birch, and aspen complex. Most of the sport hunting pressure in Alaska is exerted on these herds which are accessible from the Richardson, Glenn, Steese, and Taylor Highways.

Reindeer increased rapidly following their introduction about 1900, and by 1935 much of the coastal ranges were trodden and eaten beyond immediate recovery. The reindeer suffered from malnutrition, predation, and poor herding. They interbred with caribou and perhaps all of the caribou today carry reindeer strains. Reindeer introduced on Nunivak Island have flourished and provide a sustained annual meat crop. Lichen forage has been almost entirely replaced by grasses and sedges on Nunivak.

The wolverine and wolf, long persecuted under the impetus of territorial and state bounties and the efforts of predator control agents, have a wide range encompassing most of Alaska. Both species inhabit the rain forest as well as the interior forests but their range is more directly associated with prey than with vegetative cover. The annual kill varies from 200 to 1,000 for each animal. The porcupine, too, is found throughout all of Alaska forests, both large and small tree forms.

Beaver and marten are important cash crops which are always associated with the forest, marten with spruce, and beaver with willow, aspen, or cottonwood.

Since the days of Russian occupation, Alaska, like sister states, has been subjected to introductions and transplants of many forms of wildlife. The forester will be interested in the successful establishment of Olympic elk on Afognak Island, Sitka deer in Prince William Sound and Kodiak Island, mountain goat on Baranof, and bison in the Tanana Valley.

Conclusion

The wildlife of Alaska is a part of the forest, but a part of other plant communities as well. Few species are forest type-specific and all use transition stages of forest cover. In size, diversity of climate, elevations, and vegetation Alaska provides for a wide variety of big game, upland game, fur bearers, waterfowl, fish, and smaller forms of mammal and bird life. Each environmental factor is important in the scheme of things but none is sufficient unto itself.

Interior Reports on 1959 Fires

In 1959 on lands administered by the Department of the Interior there were 3,202 fires compared with 3,490 in 1958. The total area burned in 1959 was 967,256 acres in contrast to 856,750 acres in 1958. The 10-year average is 1,284,900 acres. Of the total burn, forest lands accounted for 50.1 percent, and of all acreage burned, 60.6 percent was in Alaska. Lightning caused 1,570 fires compared with 1,680 in 1958; man-caused fires totaled 1,632 compared with a 10-year average of 1,488. Smoker fires fell off considerably while camp fires, debris burning, incendiary, lumbering, railroad, and miscellaneous fires rose above the 10-year average.

The Fish and Wildlife Service reported the third consecutive good year with 87 fires burning 5,001 acres. Losses in the National Park Service were held to 2,619 acres. The Bureau of Indian Affairs reported losses of 82,749 acres, about 50 percent of the 1958 total. The Bureau of Land Management experienced losses of 876,887 (20 percent below the 1958 level), of which 586,535 acres were in Alaska.

Alaska Forestry—A Research Frontier

A. E. Helmers

ALASKA is a true frontier—one made of remoteness, and of economic, sociological, and psychological barriers. This frontier is a 586,400-square mile land of extensive natural resources with immense development potential that will be utilized as technology and economic conditions provide opportunities. Alaska is also a forest research frontier with a unique opportunity to develop a scientific basis for wild land management in time to meet the needs of land owners and managers.

A great industrial future for Alaska is in its forests—in wood production and utilization. Substantial production is a long-range forecast for the interior forests but closer at hand in the coastal forests. In fact, a start in the use of the forest resource on a large scale in Southeast Alaska is represented by a 350-ton pulp mill (later enlarged to 550-600-ton capacity) established in 1954 and a second plant of 450-ton capacity in production earlier this year on the Tongass National Forest. The timber volume cut last year on this national forest was somewhat less than one-fourth of the volume that is now annually available for harvest. Utilization of the interior forests has a longer way to go—the annual cut is a fraction of one percent of the annual growth. Research is the key to the ultimate industrial and economic potential of the extensive coastal and interior forests.

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Two Worlds—Coastal and Interior

"Alaska is different" is a truism usually applied in comparison with the other states. The remark is accurate within Alaska's borders too—regional differences can be expected in an area so large. Climatic differences and associated distinctive forest cover types are a handy basis for the forester's differentiation between coastal and interior Alaska.

Annual precipitation averages about 90 inches over Southeast Alaska as a whole. To the northwest, along the Gulf of Alaska coast, annual precipitation ranges from 60 to well over 100 inches. The temperature range of the maritime climate is narrow, with cool summers and mild winters. This is the belt predominantly of Sitka spruce and western hemlock forests. Associated species include Alaska-cedar, mountain hemlock, and western redcedar.

The continental climate of the interior is marked by a low annual precipitation, averaging 13 inches in the interior basin, and temperatures that have ranged from 100° to —76°F. The soils over much of the interior are underlain by permafrost (permanently frozen ground) that restricts soil water movement and which provides a supply of nearly ice-cold water for the soil layers above. Plant development during the interior growing season is rapid because of prolonged hours of daylight. White spruce, paper birch, and aspen are the principal species of commercial potential. Other common species include black spruce and balsam poplar.

Coastal Alaska

The Old-Growth Forest

Over 90 percent of the commercial land is an all-aged overmature and defective forest in which increment is largely offset by mortality and decay. Lack of disturbance and the cool, moist climate favor formation of deep layers of moss and unincorporated humus that are unfavorable for forest regeneration.

Preliminary tabulations of the Forest Survey show that volume in Southeast Alaska old-growth averages slightly less than 35 M board feet per acre. Stand composition by volume is about 65 percent western hemlock, 30 percent Sitka spruce, and the remainder consists of minor species such as western redcedar,[1] Alaska-cedar, and mountain hemlock. The coastal forests to the westward are of about the same general character but we know less about areas and volumes—an inventory is progressing, however.

The foremost silvicultural task in coastal Alaska is the conversion of old-growth to thrifty managed forests. Clearcutting is the silvicultural system best suited.

Silviculture and management research.—The first studies of natural regeneration and related silvical problems in clearcuttings were made from 1924 to 1934. Early studies in a few small clearcuttings

[1]The northern limit of western redcedar occurrence is on the northern shores of Sumner Strait, about 56°30′ N. latitude.

of the day showed that all were restocked in 10 years. Indeed, one can look at these small early cuttings (Fig. 1) and conclude that natural regeneration is not a problem. Modern pulp timber harvesting is a large and complex operation, however, that creates many new problems on a wide variety of soil and stand conditions.

In July, 1948, the Alaska Forest Research Center was established in Juneau[2] for full time studies connected with the new pulp industry and future forestry. Much of the early work of the research center was the development of "working tools" such as cruising methods, the construction and testing of volume tables and long-log scaling tables, and the use of 1:20,000 low oblique air photos for timber surveys. The study of reproduction on the older cuttings was another early project.

Research on various aspects of natural regeneration was started as clearcutting, which began in 1953, progressed on Maybeso Creek.[3] One of the clearcuttings was a mile square (Fig. 2) for studies of the amount and distance of seedfall. Natural seedfall is adequate up to 20 chains from an effective seed source, according to results thus far. Advanced seedlings, seedlings that survived logging, are an important component of the new stand. The ultimate history of advanced and new seedlings in developing an established stand is under study now.

Clearcutting makes a drastic change in site conditions. We have obtained information about seedbed types, and the effects of drainage and seedbed conditions. Information also has been obtained on microclimate, soils, and on direct seeding to establish reproduction before brush competition develops. Direct seeding using helicopters may offer some control of species composition and it may be an economical method for prompt restocking. The possibilities have not yet received the benefit of controlled experimentation, however.

Canadian and "Stateside" results are a good background in many aspects of seed production and handling and artificial forestation. Studies to develop local applications are in the future plans. The field of genetics and the possibility of obtaining stands of improved growth and quality through the use of better seed is unexplored. Scrub stands are common in the commercial forests and are a source of seed for adjacent clearcuttings. Live cull trees on the cutover areas are another seed source. The seed production of these stands and trees has been measured but the genetic characteristics are unknown.

"Working tools" are in an early stage of development. The transportation and storage of mixed sawlogs and pulp logs in rafts creates measurement and grading problems that need study and which are important in timber sale administration. Modern cruising methods, especially for smaller timber sales, have applications in Alaska but need adaptation to rugged terrain, dense undergrowth, wet weather, and local stand characteristics. While large-scale timber utilization is just beginning there is an especially good opportunity for the development of entirely new concepts in the measurement of logs, trees, and stands—a new and wide-open field for the mensurationist.

Salmon stream studies.—Spawning streams essential to maintaining the Alaska salmon resource are an integral part of many watersheds supporting the timber resource. Thus there is a close relationship between the salmon fishery, for years the largest industry in the state, and the rapidly developing timber industry. The effects of logging on salmon spawning streams must be determined as soon as possible. In 1949 the

[2]An interesting sidelight is that most of the studies in the late twenties and early thirties were made by Ray F. Taylor. He returned in 1948 to establish the new research center. Thus Dr. Taylor was directly responsible for virtually all forest research in Alaska from the beginning in 1924 up to 1959 when he retired.

[3]Now the Maybeso Experimental Forest. The area is located in Twelvemile Arm, Kasaan Bay, Prince of Wales Island.

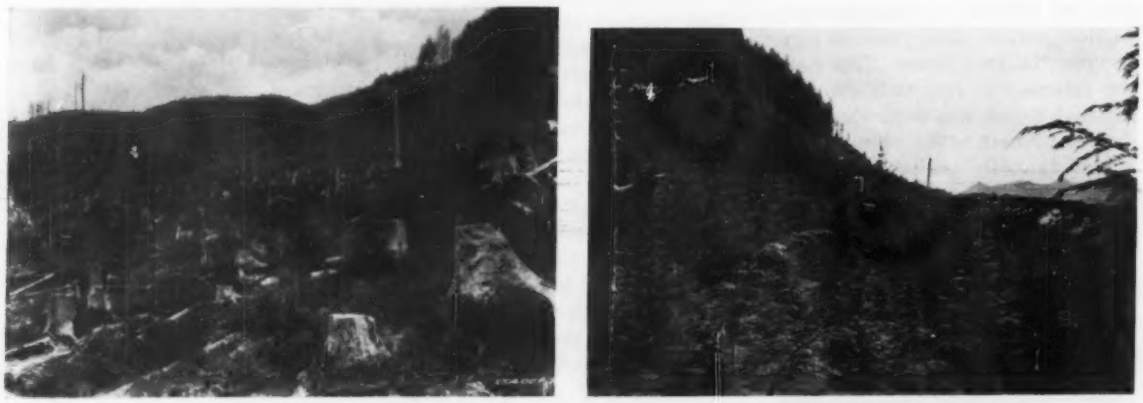

FIG. 1.—One of the largest clearcuttings of pre-pulp mill days in Alaska—an area cut for sawtimber and piling in 1925. *Left*: As it appeared in 1930. The vegetation cover was complete in two years. Tree reproduction was appearing above the herbaceous cover four years after the cutting. *Right*: The same area in 1953, but a view at right angle to the view left.

Alaska Forest Research Center started a study for this purpose based upon the current Forest Service requirements in logging methods. According to the studies these practices have not adversely affected physical characteristics of streams thus far.

The interpretation of salmon stream conditions must be based upon the environmental requirements of salmon. The need for biological studies in support of such interpretations brought about a cooperative program between the Fish and Wildlife Service, Fisheries Research Institute (University of Washington), and the Forest Service in 1956.

Dissolved oxygen content of within-gravel water, gravel movement, and temperature are major factors affecting survival of salmon eggs and larvae.[4] In terms of forestry the first two factors mean minimizing erosion and sediment production on the land. In this region the last two factors are mainly related to weather variations causing severe floods and abnormal temperatures. Under natural conditions the effects are great compared with the effects attributable to closely regulated logging. Nevertheless, alterations of watershed cover may affect streamflow factors of the salmon environment—favorably or unfavorably depending upon the direction and amount of change. Streamflow and sedimentation are important parts of current studies.

As knowledge accumulates one can visualize an attractive possibility for the future—as expressed by the Fisheries Research Institute:[5] "It appears to be practical to improve spawning areas in order to create better runs than exist naturally or to correct for any man-made changes in the streams." Indeed, we should expect eventually to have forest management and harvesting methods correlated with salmon stream improvement. It would take a lot more knowledge than either foresters or fisheries biologists have now. But harmonious development and utilization of two such important renewable resources is worth intensive research. Borrowing again from the FRI: "The theory is sound: the logic is there. The task ahead is actual experimentation in the field where the salmon spawn and die."[6]

Fire research.—Fire is uncommon in coastal Alaska, particularly in the Southeast; it has occurred rarely in the old-growth forests. Clearcutting is a new situation, however, and completely exposes large areas of slash and soil surface to drying conditions. In spite of the high summer rainfall there are occasional dry periods lasting long enough to create hazardous burning conditions in clearcuttings. A prescribed burn several years ago showed that fire will travel in 3-year-old logging slash after only 6 rainless days. Although a very light burn resulted, the experiment showed the woods were not made of asbestos after all. More recently a wildfire in fresh and 1-year-old logging slash burned with an intensity comparable to successful prescribed burns in similar forest types in Oregon and Washington.

The possibility that fire can be used for silvicultural purposes is pure conjecture at this time. However, there is a need for reduction in slash volumes to reduce the physical impediment to regeneration as well as to reduce the fire danger in newly regenerated cuttings. The seedbeds in cutover areas can be improved to advantage. These factors alone make controlled use of fire a tool worth investigation.

Fire weather observations have been obtained for a number of years at several locations to obtain a basis for a fire danger meter. Recent fire occurrences in logging areas show that to plan for adequate protection will require research on the amounts and types of fuel, how they respond to drying factors, and how fire behaves in these fuels.

Forest insect research.—An epidemic of black-headed budworm and the hemlock sawfly started about 1948 in the southern part of Southeast Alaska and swept through all of coastal Alaska before subsiding in 1955. The net loss of hemlock, the primary host, was 268 million board feet. An intensive study of the two insects was made beginning in 1952 when an entomologist was permanently assigned to the research center. Dangerous population levels of the budworm and sawfly were again found last August in the southern portion of Southeast Alaska. If the outbreak continues to increase in severity, moderate to heavy defoliation and some permanent damage may appear this year. Because control may be needed to avoid

[4] Ibid.

FIG. 2.—Clearcuttings in the Maybeso Experimental Forest, Prince of Wales Island, Alaska. The largest cutting is an experimental one-mile-square clearcutting.

[4] Royce, W. F. On the possibilities of improving salmon spawning areas. Twenty-Fourth North American Wildlife Conference, Transactions. pp. 356-366, 1959.

[5] Fisheries Research Institute. Logging and salmon. Coll. of Fisheries, Univ. Wash. 12 pp. 1959.

losses of hemlock pulp timber, the need for information on the effects of aerial spraying on salmon spawning streams has been discussed seriously in the last year by the Fish and Wildlife Service, State Department of Fish and Game, and the Forest Service. Studies of such effects should precede large-scale spraying operations.

Another recent noteworthy insect infestation was the 1942-1948 outbreak of the Sitka spruce beetle on Kosciusko Island. Nearly 30 percent of the merchantable spruce in the 6,400-acre infestation area was killed. This stand was generally regarded as the finest stand of spruce in Southeast Alaska. It may be necessary to control such infestations in the future; but information on biology, ecology, and control is lacking.

Insect detection and appraisal surveys are the major part of the research center activity in forest entomology. This is a monumental task for one man in a forest land area larger than the combined area of Washington, Oregon, and a third of California. The excellent cooperation of other agencies is a major factor in keeping informed about unusual and important forest insect occurrences. A program of systematic annual insect collections and observations to serve the needs of both detection and appraisal surveys and research, has been designed and field tested. The system is adapted from successful Canadian methods designed to obtain current information on forest insect activity as well as to add to the knowledge of insect biology and ecology.

Forest disease research.—The most recent tree disease study by visiting pathologists was a study of cull factors for Sitka spruce, western hemlock, and western redcedar. Cull averages about 50 percent in the poorer old-growth stands and 30 percent in the better stands. The cull indicators developed are valuable aids in scaling and cruising. Due to the long time it will take to cut all the old-growth there is a need for additional research in forest diseases in order to have more precise information on sound wood volumes available and to improve the accuracy of scaling and cruising.

Forest products utilization, economics, and marketing research.—About 9 billion board feet of cedar in Southeast Alaska is virtually unutilized because markets are lacking. Logging methods necessitate cutting the cedar along with the hemlock and spruce, but without a market the cedar is usually wasted. Research is needed to determine economical manufacturing methods and to develop new uses and products.

All treated wood products used in Alaska are imported from the other states. On several occasions there has been interest in a treating plant in the Anchorage area. Studies are needed to determine the potential markets for treated wood, the costs of treating, and on the suitability of local species for treatment.

Greater development of wood-using industry in Alaska, and better utilization of timber, could result from studies of using various grades of logs for their greatest economic benefit. The old-growth stands of coastal Alaska are mainly pulp-quality material but they contain high-grade logs suitable for other uses.

A considerable portion of the timber resource is physically or economically inaccessible to present harvesting equipment and methods. Before substantial volumes of timber can be harvested and utilized economically, much study must be given to equipment and methods especially designed for Alaska conditions. Steep topography, logging across muskegs and soft ground, and water transportation of logs and products are problems.

Most of the lumber used in Alaska is imported from the Pacific Northwest. Local lumber does not supply as much of the local needs as it should. Much of the sawmilling produces a low-grade product. The needs are for more efficient operations, better seasoning, modern equipment, distribution facilities, more competitive shipping methods for local products, and more readily available financing and credit. Special work in mill-scale and grade recovery studies is needed to improve manufacturing and obtain better utilization.

Wildlife research.—Wildlife ranks high among the resources of Alaska with returns in recreational, scientific, and aesthetic values, and commercial values in meat, fur, and miscellaneous products. The intricate relationship between forests and wildlife means, of course, that wildlife management is prominent in planning the management of forests. There is a background of information on wildlife, but large-scale pulp logging is creating new problems.

The Fish and Wildlife Service and the Forest Service are cooperating on observations to help determine how forest management practices can be applied to protect and maintain the world-famous brown bear. The problem needs intensive research. Another big-game problem is the management of Sitka black-tailed deer. Game biologists have studied the ecology of deer under old-growth forest conditions. Logging by the new pulp industry is creating a new environment that brings about the need for new studies. As a start, the research center and the Fish and Wildlife Service have established a small study on ecology of deer browse on one of the first of the recent clearcuttings. Browsing use of forest range by moose is another wildlife problem. Of direct concern to the forester, and related to regeneration, is the problem of small mammals, both as consumers of seed and as seedling damaging agents. Small mammals troublesome in obtaining natural regeneration and in direct seeding have been identified. Studies of the ecology of small mammals are progressing in an uncut forest and a new clearcutting.

The New Forest

The conversion of the uneven-aged old-growth to even-aged

stands is needed to develop the full wood-producing potential of coastal forest lands. About 10 percent of the commercial forest in Southeast Alaska is even-aged, resulting mainly from blow-downs, a few fires, and old cuttings. Such stands represent the desired forest. These new stands have about double the volume of wood per acre found in old-growth stands. Species composition is about half spruce and half hemlock, humus conditions are generally favorable.

Cutting in the even-aged stands will begin sometime before the old-growth is completely utilized—perhaps several decades from now. When the forester arrives at that day he will face management and silvicultural problems that are entirely new. We have the opportunity to obtain a scientific basis for management before the manager faces the problems. There is virtually no research in any aspect of even-aged forest management in Alaska. The small area of what represents the thrifty even-aged forests of the future are the present opportunities for studies of harvest and intermediate cuttings, regeneration studies, and associated fundamental research on physiology, soils, genetics, and protection.

Early studies of growth and yield started in 1924 and culminated in 1934 in a publication[7] on yield of second-growth western hemlock-Sitka spruce stands in southeastern Alaska. This information will be an important element in planning for management of the new forest. The informational "bridge" in the conversion from old-growth to even-aged stands is in need of more study. For example, in planning for the future, the manager needs a method of determining from indicators available in an old-growth stand, how much wood a thrifty even-aged stand will produce on the site. One method developed by the research center relates the potential of even-aged stands to "log-height" or merchantable height classes of the old-growth stands.

Thinning and partial cuttings are a good possibility in managing even-aged stands for saw logs and pulpwood. A study in one stand shows that a pulpwood volume equal to the per-acre volume of present old-growth stands could be removed in thinning and still leave a good stand of the better trees to put on quality growth for sawlogs or for increased pulpwood yields. Studies such as this are a beginning that shows what can be gained from intensified research in even-aged forests.

Interior Alaska

The forests of interior Alaska are, with very minor exceptions, the only boreal forests or "taiga" in the United States. They are a completely new challenge in all aspects of research. The research needs can be summed in one word —everything! With large-scale development of interior timber industries several years in the future, the big opportunity is for the development of a scientific basis for sound forest management planning —in time to meet the needs of the manager.

Alaska's interior forests cover almost 120 million acres. Forty million acres of this is commercial forest land supporting 32 billion cubic feet of timber, an average volume of 800 cubic feet per acre. Mature stands on good sites contain about 3,900 cubic feet or 15,500 board feet per acre. The mean annual net increment on such sites is 24 cubic feet, including 97 board feet of sawtimber. This is a total of 1 billion cubic feet of growth annually including 3.9 billion board feet. Net growth can be much greater—annual mortality is estimated to be 360 million cubic feet. About half of this is due to fire. These statistics are simply the best estimates available. The first real inventory of the interior forest resource has just begun. Despite the absence of precise statistics, however, it is apparent there is a large forest resource. Present losses should be substantially reduced to have this resource available when it is needed.

Forest management research.—A study of the ecological effects of forest fires,[8] made during the summers of 1949 to 1952 in cooperation with the Bureau of Land Management, was the first substantial forest research in interior Alaska. This important study provides most of the currently available information on forest succession after fire and on the effects of fire on soils, wildlife, and the water resources in the interior.

Forest management research was started on a permanent basis in 1957. Our Fairbanks field headquarters is currently a one-man office. Most of the present effort is on studies of yield and volume tables for commercial species. Studies in dendrology, natural and artificial regeneration, and harvest cuttings are also in progress.

A background for research is available from Canadian studies and from northern Europe. But the unique character of the forests results in unique silvical and silvicultural problems; for example, the cause and effect relationships of permafrost and forest vegetation and the effects of exceptionally long hours of daylight. Special regeneration problems result from disturbance: the millions of acres of burned forest land; and the absence of disturbance: winter logging. Wildlife is an important consideration in forest management. Important forest products include not only wood, but also the furbearers and big game that are an established factor in the economy of the region.

Fire research.—How to obtain adequate fire protection is a big problem in the interior today. Fundamentally, the factors of the fire problems are similar to those in the western states, but there is a considerable difference in degree. Some of the basic problems are distance and time in a huge geographic area, limited road system,

[7] Taylor, R. F. Yield of second-growth western hemlock-Sitka spruce stands in Southeast Alaska. U. S. Dept. Agric. Tech. Bul. No. 412. 30 pp. 1934.

[8] Lutz, H. J. Ecological effects of forest fires in the interior of Alaska. U. S. Dept. Agric. Tech. Bul. No. 1133, 121 pp. 1956.

5-6 month fire season with 20-24 hours daylight, high evaporation rates, annual precipitation of 8-15 inches, continuous cover of flashy fuels that burn intensely and with a high rate of spread, 60-day lightning season, limited centers of population and supply, and a high risk of man-caused fire in widely scattered remote areas. Fires are so much a part of the summer scene that there is also the psychological problem of getting public recognition of the economic losses due to fire. Besides timber, there are losses such as the habitat for furbearers and big game, reindeer and caribou range, waterfowl nesting grounds, watershed stability important to the hydroelectric potential of the region, and the scenic and recreational values of green forests.

Alaska's huge roadless areas of flammable forests have suffered heavily from man-caused and lightning-caused fires. About 80 percent of the interior forests have burned over at least once since the late 1890's.

Today's orthodox fire control methods applicable in other states will not work well under interior conditions. Fire control in the interior calls for an entirely new approach to the detection and control of forest fires—one geared to the air and appropriate in undeveloped timberlands. The Bureau of Land Management, the fire protection agency in interior Alaska, has made significant advances, such as the use of smokejumpers, air dropping equipment and supplies, aerial application of fire retardants, aerial detection methods, and fire fighting techniques. The measurement and prediction of fire weather is starting. Research on prevention, fuels, fire behavior, fire weather, detection, and suppression, and fire effects is essential to reduce fire losses to an acceptable minimum.

Forest insect research.—The amount of insect damage in interior forests is unknown, but a few epidemic areas have been examined. An infestation of a spruce engraver beetle north of Fort Yukon was epidemic sometime before 1955 and covered an area of 1,800 square miles by the time natural factors reduced it to an endemic status. The loss of white spruce averaged 40.3 cubic feet per acre.

An outbreak of the spear-marked black moth in birch stands in the Tanana Valley started in late summer of 1957 spread over 5,829,000 acres before controlled naturally by a virus disease and insect parasites. The research center made use of the epidemic to study the biology and control of this insect. Outbreaks were previously unreported in Alaska.

Several epidemics of the Alaska spruce beetle are known in recent years. There is currently a 16,000-acre outbreak in white spruce and Sitka spruce on the Kenai Peninsula just south of Turnagain Arm in which small-scale studies of the insect and of control methods are planned.

Studies of forest insects in the interior have been confined largely to periodic extensive surveys of outbreaks and to some research on the biology and ecology of the spear-marked black moth. A program of systematic sampling of insect populations was field tested in interior and Southeast Alaska. When this program becomes operational it will lead to a better understanding of the role insects play.

Forest products utilization, economics, and marketing research.—The principal products of interior sawmills are house logs and rough lumber using white spruce almost exclusively. In spite of a good demand for lumber the interior mills fail to capture the market potential, largely because of their low-grade product. Practically all of the finished lumber and most of the construction lumber is imported. Local lumber hardly competes with the expensive imported products because of high labor costs and the substandard quality of the local product. To help local sawmills fill a greater part of local demands there is a need for study and technical assistance to improve mill layout and milling methods, methods for air seasoning and kiln drying, and grade sawing. There is a need for marketing research and for studies to reduce unit costs and increase production. High speed gang mills are a good possibility. In the summer season there is much wet ground that might be logged more successfully with specialized equipment.

Birch is available in large quantities and suitable for such varied uses as pulp, furniture stock, veneer, flooring, paneling, turned articles, and small dimension stock. Under present conditions the best possibility for establishing birch utilization is research to determine how to log, mill, and handle the species under interior conditions for local use and for export. Such research should include economic and marketing studies. Cottonwood is another species available in substantial volumes worthy of utilization and economic studies.

Increasing numbers of requests for information on various aspects of wood utilization, a number of small but successful specialty product shops, and several "almost successful" larger scale attempts to manufacture birch products lead to the belief that research and technical assistance might tip the balance toward a greater and more economic utilization of the timber supply. Economic advantages will bring in wood-using industries eventually. But know-how gained from research can speed up industrial development.

The Inventory of Alaska's Forests

Reliable data on the extent, volume, and quality of timber; on losses; and on the growth potential of the forest resource were obtained only recently in Southeast Alaska. On the Chugach National Forest part of coastal Alaska and in the interior this information is still based on guesses by foresters. Informed opinion is valuable information but as industry develops there is a need for data of known accuracy.

The 83rd Congress authorized

the extension of the Forest Survey to Alaska. In 1954 the Forest Survey started an inventory of Southeast Alaska forests. Field work is completed and statistical summaries are nearly finished. Aerial photo and field work for the Chugach National Forest will be completed in a few years. Aerial photography for the interior is planned for completion by fall of this year. Photo interpretation also will be well underway by then.

Completion of the initial Forest Survey of Alaska is planned for 1962. It is a tentative date, subject mainly to the vagaries of weather and forest fires which have a profound influence on aerial photography and on field work handled by light planes, helicopters, and boats.

Alaska Forest Survey sampling and statistical methods are similar to methods used in the other states except that more time and reliance is placed on aerial photo interpretation in order to reduce difficult and costly plot measurements and to survey a large area within a reasonable length of time. A sampling technique is used in which systematically located plots are studied on the photos and classified by land type, forest type, stand size and density. A portion of the interpreted plots are selected for field examination to check the accuracy of the photo interpretation and serve as the basis for volume estimates. For the interior the method is modified by examining about 10 percent of the photo plots from the air in a light plane. The ground plots will be drawn from air checked plots and will be the basis for adjusting both the results of aerial examination and photo interpretation.

Forest Survey results are put to immediate use in Alaska. The area and volume estimates are the basis for estimating allowable cut and for planning timber sales to supply the new pulp mills. Other new industries are planned, now that more reliable information on volumes, quality, and location is available. The results of this first extensive look at Alaska's forests will serve to guide subsequent more intensive studies and surveys.

Summary

Alaska, well known as a frontier in terms of economic development, is also a challenging research frontier. It is a great opportunity to develop the scientific basis for modern forestry in time to meet the needs of wild-land managers.

Forest research started in Southeast Alaska in 1924. During the next 10 years the major work was determining the yield potential of even-aged hemlock-spruce stands. Studies also were made of natural regeneration and associated silvical problems. Then, after 14 years without organized research, the Alaska Forest Research Center was established in Juneau in 1948.

The first 11 years of research center activity was largely in Southeast Alaska on studies of problems brought about by the rapidly expanding pulp industry and the clearcutting of old-growth forests—natural and artificial regeneration and related problems, and the effects of logging on salmon spawning streams. Research was barely started on the management of even-aged stands (the future forests of Southeast Alaska) and on the silvics, silviculture, and growth of the commercial species of the interior. The research center has maintained a program of forest insect surveys and a small amount of insect research. An inventory of the timber resources is about completed for Southeast Alaska, and well under way for the Chugach National Forest of the Gulf of Alaska area. An extensive survey of timber resources in interior Alaska is in progress.

The industrial future of Alaska is in natural resources. Forests are one of the renewable natural resources with the greatest economic potential. The ultimate contribution of Alaska timber to the economy of the state and to meeting the local, North American, and world needs for wood is not yet precisely defined. But the potential is great. In realizing this potential, much depends upon the effectiveness of forest research—the key to intensive forest utilization and management.

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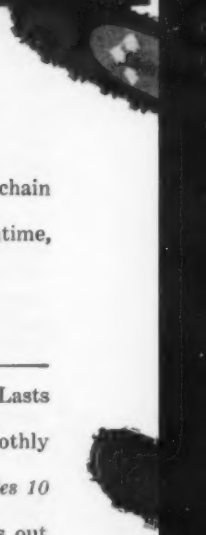

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The Timber Industry and Industrial Forestry in Alaska

Archie M. Byers

TODAY the timber industry in Alaska is beginning to develop the potential that has long been dormant while awaiting favorable economic conditions. Ten years ago the annual log scale in Alaska was less than 100 million board feet. In 1960, it should reach five times that, and the value of the products shipped from Alaska's forests will probably be ten times what it was in 1950, even adjusting for the decreased value of the dollar. This is chiefly the result of the establishment of two large dissolving pulp mills, one built by Ketchikan Pulp Company near Ketchikan and the other recently completed by Alaska Lumber and Pulp Company at Sitka.

To provide a proper frame of reference for a discussion of the industry as it is presently operating, it is first desirable to present a brief history of economic development in Alaska and a description of the present business and social climate in the 49th State.

Economic Development

Alaska's economic history began with the discovery and exploitation, by aggressive Russian entrepreneurs, of one of its great natural resources, fur, particularly that of the sea otter. As Russian Alaska became firmly established, there was some use of other resources of the area, minerals, fish, and timber. Near Sitka there are still to be seen the stumps of trees cut by the Indians under Russian direction and hauled by brute manpower to river or bay for floating to the local sawmill. However, except for fur and a few minor manufactures, the Russian era in Alaska was not distinguished by development of trade or industry.

From the time of the purchase of Alaska by the U.S.A. in 1867 to the beginning of the twentieth century, two more of Alaska's resources, its minerals and fish, began to be exploited by American interests who were as aggressive in these fields as the Russians had been in the pursuit of fur. The forest resource was used only locally for most of this period except that a sawmill, Ketchikan Spruce Mills, became established and exported spars and timbers to world markets. This company still plays an important part in the lumber industry of Alaska.

From 1900 until the beginning of World War II, fishing, particularly for salmon, and mining, chiefly for gold, were the mainstays of Alaska's economy. The country's great natural resources were providing the livelihood for most resident Alaskans and a substantial return on invested capital for ownership, mainly non-resident, of the extractive industries. Population and political power were located mainly in southeastern Alaska, although Fairbanks, Anchorage, and other westward and interior settlements were well established. The timber industry made some progress, and sawmills in southeastern Alaska had a total output of about 75 million feet annually, specializing in clear spruce lumber. There was minor activity to the westward, particularly at Whittier, the southern terminus of the Alaska Railroad.

The War Period

With World War II came a tremendous change. Construction crews and servicemen poured by thousands into Alaska to build and staff new military establishments. Almost all this development was in westward and interior Alaska, and overnight Anchorage and Fairbanks became the centers of Alaskan population and political influence. The extractive industries were finding rough going, fishing because of over-exploitation and consequent diminishing runs, and mining because of a fixed price for gold and ever-increasing operating costs. The timber industry experienced an upsurge due to lumber orders for defense construction as well as a demand for high grade spruce in aircraft production. During the wartime construction boom, wages were pushed higher and higher to attract workers for the essential military projects until an almost unbelievable scale became established. The older extractive industries were forced to pay nearly comparable rates or be closed for lack of manpower. This high wage development is still exerting a major influence on the Alaskan economy.

The Post-War Period

The post-war period saw a continuation of the importance of military construction and military establishments. Anchorage became a city of more than 60,000 and Fairbanks reached a population over 20,000, out of a total state population in 1959 of 210,000 persons. The fishing industry began to stabilize, but at a low produc-

THE AUTHOR was formerly woods manager, Alaska Lumber and Pulp Co., Inc., Sitka, Alaska.

tion level, and the mining industry declined to near insignificance. The sawmill business receded somewhat from peak wartime activity, but was relatively healthy, the annual cut being roughly 100 million board feet.

Concern was expressed by many, both within and outside Alaska, that the old established economy of Southeast Alaska could not be sustained, much less demonstrate healthy growth. Frank B. Heintzleman was the prime mover in a campaign to promote new industrial establishments, based on the forest resource, for the major communities of the area. The Territory of Alaska made important tax concessions to new enterprises and the U. S. Forest Service completed preparation of several large long-term timber sales for auction to bidders who would contract to establish major forest industries in return for a dependable supply of raw material. This effort coincided with the post-war period of expansion in world timber production and with the great demand by war-damaged and under-developed nations for all types of forest products.

Although the general world business outlook was fair and there seemed to be pressure on other American forest resources, some disadvantages to major investment in Alaska required careful evaluation by potentially interested managers of available capital. The high wage levels established by wartime military construction have been mentioned. Low population, spread over a tremendous area, meant that costs of government, and therefore taxes, were at a high level. Also, nearly all forest products had to be exported to distant markets. Materials, services and labor sources were far away and transportation to Alaska was expensive. Although there was an apparent abundance of wood, both volumes per acre and individual tree volumes were low compared with those in the Pacific Coast states. Topography was generally very rough, steep and broken, and ground conditions unfavorable, tending to extremes of softness and hardness. In most areas, transportation to mill-sites would subject logs to hazards of wind and water not encountered elsewhere. Furthermore, establishment of both mills and logging operations would require the attraction of competent labor, not too easy in times of a booming timber economy elsewhere. Some concern was felt at the dominant part beginning to be played in territorial politics by powerful labor organizations and at the public attitude toward absentee ownership of the older extractive industries. Balanced against these detrimental factors was, of course, the offer of substantial wood reserves at relatively cheap stumpage prices.

Recent Expansion

That is the background leading to the mid-century expansion of the timber industry in Alaska. Between 1950 and 1960, two new dissolving pulp mills have come into production, and a modern sawmill was scheduled to commence operation at Wrangell for Pacific Northern Timber Company early this year. Another major plant, a newsprint mill, is, by terms of a preliminary award of contract, to be constructed at Juneau within the next few years. Provision is made for future establishments, in conjunction with the new Wrangell sawmill, of a small pulp mill, the process still undetermined.

This, then, is the forest industry in Alaska today: dissolving pulp mills at Ketchikan and Sitka, with daily capacities of 575 and 340 tons respectively, older sawmills at Ketchikan, Wrangell, Juneau, and Sitka, and a second sawmill, specializing in the production of kiln-dried hemlock lumber, nearly complete at Wrangell. Total log requirement for these plants is approximately 500 million board feet annually.

Industrial Forester's Role

All of this 500 million feet of expected annual cut is to be produced under timber sale from the Tongass National Forest. The regeneration and care of cutover lands are the responsibility of the Forest Service. Fire protection is the logger's responsibility only on the operating area. With no private land ownership, incentive for private investment in stand improvement work, most types of research, and other normal activities of an industrial forestry staff in other states are lacking. What then is the role of the industrial forester here? He has two major activities. First, inventory checking and related collection of information, and second, the practical planning and administration of timber harvesting.

When the high cost, high wage, high tax economy of Alaska is remembered, as well as the prevailing rough topography, generally unfavorable ground conditions, low volumes per acre, transportation and communication difficulties, and the economic disadvantage of a long haul to the markets for forest products, it is apparent that economic operation calls for the ultimate in efficient management and the adaptation of the best techniques applied in other forest areas, as well as ingenuity in the development of plans and procedures particularly suited to local conditions.

Inventory programs have been of great importance in the early stages of each new timber enterprise, and will continue to demand attention for many years. Methods have varied slightly between companies, but that used by Alaska Lumber and Pulp Company is typical.

Vertical aerial photography on a scale of 1:9600, the provision of two sets of prints, and the production of planimetric maps at a scale of 1 inch to 800 feet was contracted for with H. G. Chickering, Jr., consulting photogrammetrist of Eugene, Ore. The area of the first 10-year operating period outlined by the timber sale contract was flown early in 1957, and a further somewhat larger area early in 1958. Pretyping into approximately 50 types was done directly on the photographs and then a modified random sample of sufficient plots to give

about 2 percent coverage in each type was outlined. Field crews, making use of boat, plane, and helicopter transportation, then took accurate tree measurements on the plots laid out and ran chained compass lines between plots. Ground and slope conditions and any other information considered helpful in operational planning were noted at the time by the field crews.

After completion of field work, re-typing was carried out on the photographs, type and topographic information was transferred to the planimetric maps, and volume tabulations compiled for types and operational units. This procedure provided the required information at an acceptable cost. Refinements of technique have been developed as experience was gained, but the basic method is satisfactory and unchanged.

The industrial forester engaged in operational planning and management must have a basic interest and experience in all logging methods used on the Pacific Coast, and must, in addition, be able to analyze available shows to determine the most economic type of development, giving careful consideration to the special characteristics of the Alaska cost situation. Individual shows vary widely, of course, in difficulties presented but in general the objective of operational planning in Alaska is the highest attainable production per man-day by full use of all facilities and judicious capital investment to lower manpower requirements.

Logging operations in Southeast Alaska vary from four-man to 200-man camps, and from simple cat logging shows through normal Pacific Coast high-lead operations to modern versions of the oldtime slackline and skidder systems. There are cat swings, electric arch swings, truck shows, and A-frame operations, and combinations of these, selected as necessary to fit the particular show. Equipment varies from the ancient to the latest prototypes, the newer operations of the pulp companies being outstanding examples of modern logging practice.

A typical pattern of log supply to the major conversion plants in Alaska provides for about 70 percent of required wood to be obtained from the area held under long-term sale contract from the Forest Service. The remainder is purchased from independent loggers who bid in their own sales. Of the 70 percent taken from the long-term sale areas, about 40 percent is logged by company administered operations, and the remainder is delivered by contract loggers of all types and capacities.

Since the entire log supply is taken from the Tongass National Forest, cooperation with the Forest Service and planning operations so that contract requirements and adherence to the principles of multiple use of forest land are maintained are essential for those engaged in any phase of the industry. There are periodic differences of opinion and interpretation, but a good relationship generally exists between federal foresters and those engaged in industrial practice. Both parties are well aware of the importance to Alaska of a healthy forest industry on the one hand and of good resource management on the other.

It may be anticipated that the proposed newsprint mill of the Georgia-Pacific Alaska Corporation at Juneau will continue a somewhat similar pattern of woods management. When this enterprise is operational, the Tongass Forest will be close to full industrial development. There is, according to present inventory and yield data, insufficient sustained yield capacity to support another pulp mill, and the average grade of timber is not high enough to encourage development of another large sawmill under foreseeable conditions. It is probable that expansion of existing conversion plants will provide a market for all available raw material.

Outlook

There is without doubt a possibility of increased diversification in use and product. Because of transportation cost and other economic difficulties, there is some tendency to cut the upper log grades in plants closest to the point of production rather than at the plant best equipped to convert them. There has been very little utilization of sawmill waste to date, but plans are being formulated for the production of pulp chips at two or more sawmills. No profitable sustained market has yet been found for manufactured western redcedar or Alaska-cedar, therefore, some cedar log export has been permitted. Plywood and veneer production was attempted at Juneau during the post-war period, but the future does not appear bright for these products. It seems likely that the timber industry in Southeast Alaska will stabilize in roughly 10 years' time with one small and three large pulp mills and about a half-dozen sawmills with a total annual log requirement of about 800 million board feet. Depending on economic trends, there may be opportunities for development of board plants, pole and piling export, specialty production from cedar, and establishment of preservative treating facilities. This may seem unduly pessimistic to some, but it must be borne in mind that basic forest products industries are rapidly being developed in many areas of the world where low labor costs provide a favorable outlook for invested capital, and this may cut opportunities for expansion in high cost areas which do not have sufficient population to consume the products of local industry. Furthermore, a stable industry using 800 million board feet of wood annually can be expected to employ directly about 4,000 workers and have an annual product value in excess of 130 million dollars. These are certainly destined to be impressive figures in the Alaskan economy for many years.

We have, to this point, focused our attention on Southeast Alaska, which has already attracted a substantial forest industry and where further development in the near future seems reasonably assured. What is the present and potential situation over the remainder of the vast land area of Alaska? Slight

mention has been made of the industry in the westward area, particularly at Whittier. The Columbia Lumber Company of Alaska has successfully operated a sawmill at Whittier for a number of years, its main markets being the Rail Belt cities of Anchorage and Fairbanks. There are two or three smaller mills scattered from Cordova and Seward to Anchorage, their product being locally consumed. A new wood-using plant is now under construction at Whittier. This is a preservative treating plant for both sawn and round timber destined for Alaskan consumption, a venture of Koppers Company, Inc.

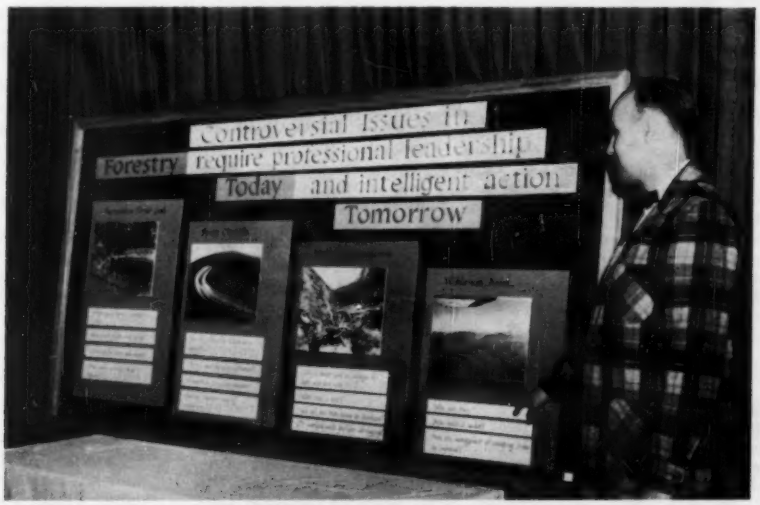
All these plants are dependent for raw material on the Chugach National Forest located in the Prince William Sound-Kenai Peninsula area. Reliable statistics of inventory, growth, and yield for this northernmost Sitka spruce-western hemlock forest are not available but there is little doubt that a pulp mill could be supported in this area, if not by the Chugach Forest alone, then by drawing on rail or highway hauled wood from the large valleys leading to interior Alaska. Serious consideration has not yet been directed toward any such enterprise, and its feasibility in the near future is somewhat doubtful, unless world demand for pulp shows an unexpectedly sharp upturn. Perhaps the most reasonable short-term prospect for growth of the timber industry in this vicinity is further expansion of sawmilling to take a greater share of the large and growing home market in the Rail Belt cities.

Last of the major forest areas of Alaska for consideration is the tremendous interior spruce-birch-aspen boreal forest. This writer has no real acquaintance with this resource except that gained by a few visits of short duration and by flying over huge expanses in commercial air liners, therefore his opinions are given with much reserve.

There has been no industrial activity in this forest except small local sawmill ventures and the cutting of mine timbers or other minor forest products. An experimental cutting of birch for veneer production was recently made in the vicinity of Anchorage, but reports were circulated that the project proved unsuccessful. It is my opinion that no major industry will be based on this resource for at least 25 years. Any prediction beyond that period is probably of less value than gazing into the well-known crystal ball. There is most certainly a potential industrial value in these stands, which are very similar in composition to some now being utilized across northern Canada, but of apparently smaller volumes both per piece and per acre. The present deterrents to development are the huge capital investment and high operating cost which would face any new timber enterprise, along with the expense of getting the product to market. Until more favorably situated forest areas are completely utilized, there is little incentive for capital to undertake even the serious investigation of this forest region although the total available volume may be of astronomical proportions.

Summary

By way of summary, it may be said that economic factors, chiefly high costs and high taxes, are dominant among the problems of the forest industry in Alaska. The industry is healthy and developing satisfactorily toward full resource utilization in Southeast Alaska. The Chugach Forest area has a potential for reasonably early major development, given favorable world pulp market conditions. The probability of early exploitation of interior Alaska forests is slight, even though tremendous volumes may be available.



PORTLAND CHAPTER exhibit, 1st prize winner, Columbia River Section meeting, Roseburg, Ore., April 22-23, 1960. See page 498.

Fifth World Forestry Congress

Seattle, Washington

Provisional Program

Opening Plenary Session: August 29, 1960.
Closing Plenary Session: September 10, 1960.
General and Technical Sessions: August 30-September 9.

First General Session

Multiple Use of Forest Lands

Keynote Address:

"The Concept of Multiple Use of Forest and Associated Lands—Its Values and Limitations." R. E. McArdle, Chief, U. S. Forest Service, Washington, D. C., U.S.A.

1. "Application and opportunities for multiple-use forestry on a geographic basis." G. G. Takle, Formerly Inspector General, Indian Forest Service, New Delhi, India; P. V. Vasilyev, U.S.S.R.; J. deVassiére, Direction Générale des Eaux et Forêts, Paris, France.

Second General Session

Multiple Use of Forest Lands

2. "Application and opportunities for multiple-use forestry on an ownership basis."
   a. In large publicly-owned forests. E. P. Cliff, Assistant Chief, U. S. Forest Service, Washington, D. C., U.S.A.
   b. In large privately-owned forests. Bernard L. Orell, Vice-President, Weyerhaeuser Company, Tacoma, Wash., U.S.A.
   c. In community forests. J. Keller, Inspecteur Fédéral des Forêts, Chasse et Peche, Bern, Switzerland.

Third General Session

Progress in World Forestry

Keynote Address:

"Role of Forestry in World Economic Development." Egon Glesinger, Director, Forestry & Forest Products Division (FAO), Rome, Italy.

1. "Forestry progress in Western Europe and the Mediterranean." M. J. Jungo, Chairman, FAO European Forestry Commission, Bern, Switzerland.
2. "Forestry progress in the U.S.S.R." V. P. Tseplyaev, U.S.S.R.
3. "Forestry progress in the Near East." M. K. Shawki, Chairman, FAO Near East Forestry Commission, Khartoum, Sudan.
4. "Forestry progress in Africa." J. G. Watterson, FAO Regional Forestry Officer, Ghana, Africa.
5. "Forestry progress in the Far East." U Aung Din, FAO Regional Officer for Asia and the Far East, Bangkok, Thailand.
6. "Forestry progress in Latin America." E. Kalkinneu, FAO Regional Foestry Officer for Latin America.
7. "Forestry progress in North America." J. D. B. Harrison, Director, Forestry Branch, Ottawa, Canada.

Section I. Silviculture and Management

Session A

Inventories of Forest Resources

1. "Selecting objectives and standards for estimating forest resources." Eric Hagberg, Director, The Swedish Forest Institute, Stockholm, Sweden.
2. "Surveys particularly applicable to extensive forest areas."
   a. Oceania. D. A. N. Cromer, In Charge Division of Forest Resources, Forestry & Timber Bureau, Canberra, Australia.
   b. South America. D. Heinsdijk, FAO Forestry Officer, Rio de Janeiro, Brazil.
   c. North America. Richard C. Wilson, Chief, Forest Survey Branch, U. S. Forest Service, Washington, D. C., U.S.A.
   d. Asia. R. A. De Rosayro, Forest Department, Colombo, Ceylon.

Session B

1. "Advances in forest survey design and procedure." Dr. R. Braun, Forstliche Bundesversuchsanstalt, Schönbrunn, Vienna, Austria, and Walter Bitterlich, Forstmeister, Salzburg, Austria; B. Matern, Forest Research Institute, Stockholm, Sweden; Prof. G. Furnival, School of Forestry, Yale University, New Haven, Conn., U.S.A.
2. "Aerial photogrammetry in forest surveys." H. E. Seely, Head, Forest Inventories Research Section, Forestry Branch, Ottawa, Canada.

Session C

Semi-Arid and Arid Land Forestry

1. "Progress in the integration of forestry and grazing." P. Margaropoulos, Chief, Torrent Watershed Section, Ministry of Agriculture, Athens, Greece; Raymond Price, Director, Rocky Mountain Forest and Range Expt. Sta., Ft. Collins, Colo., U.S.A.
2. "Advances in reforestation and afforestation practices." A. Y. Goor, Director, Forest Research Institute, Illanoth, Israel; M. Monjauze, Conservateur, Direction des Eaux et Forêts, Birmandreis, Algérie.

Session D

Modern Concepts and Advances in Silviculture and Management

1. "'Orchard' versus 'Naturalistic' Silviculture."

Panel

   a. South Africa. P. C. V. Uiers, E. K. Narsh, and J. U. Van Wyk, Department of Forestry, Union of South Africa.
   b. New Zealand. A. D. McKinnon, New Zealand Forest Service.
   c. Switzerland. Prof. H. Leibundgut, Ecole Polytechnique Fédérale, Switzerland.
   d. Finland. Erkki Kalela, Executive Director, Central Forestry Association, Helsinki, Finland.

2. "Relation between forest production and growing stock." Dr. Hubert Durr, Ministry of Agriculture and Forestry, Vienna, Austria, and Dr. Rudolf Frauendorfer, Forstliche Bundesversuchsanstalt, Vienna, Austria, and Norbert Mair, Innsbruck, Austria.

Session E

1. "Planning and control of the managed forest, including new inventory control procedure." M. Kreutzinger, Director, Forest Research Institute, Warsaw, Poland; Prof. Kenneth P. Davis, Department of Forestry, University of Michigan, Ann Arbor, Mich., U.S.A.
2. "The influence on silviculture of delivered prices of primary forest products." A. R. Entrican, Director, New Zealand Forest Service, Wellington, New Zealand; Thorsten Streyffert, Dean, Royal School of Forestry, Stockholm, Sweden.
3. "New methods of improving stand composition." H. C. Dawkins, Ecologist, Forest Department, Entebee, Uganda; Edwin F. Heacox, Vice-President, Weyerhaeuser Company, Tacoma, Wash., U.S.A.

Session F

Forest Ecology and Soils

1. "Classification, mapping and interpretation of soils for forestry purposes." Prof. W. Wittich, Institut für Waldbau-Grundlagen, University of Göttingen, Hannover-Münden, Germany; Peter Ahn, Soil Survey Officer, Division of Agriculture, Kumasi, Ghana.
2. "Intensive soil management for increased forest production."
3. "Relation of forest diseases to soils and soil management." Otis L. Copeland, Chief, Division of Watershed Management Research, Intermountain Forest & Range Expt. Sta., U. S. Forest Service, Ogden, Utah.

Session G

1. "Evaluation of forest site quality from soil topographic and climatic factors." Prof. J. L. Farrar, Faculty of Forestry, University of Toronto, Toronto, Canada; Prof. A. DePhilippis, Facoltà, Agraria e Forestale dell 'Università, Florence, Italy.
2. "The nutrient cycle and its modification through silvicultural practice." J. D. Ovington, Head, Forestry Section, The Nature Conservancy, London, England.

Section II. Genetics and Tree Improvement

Session A

Progress in Tree Improvement and Proposals for International Cooperation

1. "Progress in forest genetics and tree improvement." C. Syrach Larsen, Director, Arboretet, Horsholm, Denmark.
2. "Proposals to facilitate the exchange of breeding material." Giacomo Piccarolo, Director, Instituto Nazionale per Piante da Legno, Torino, Italy.
3. "Problems and proposals for international forest tree seed certification." Ernst Rohmeder, Director, Institute fur Forstsamenkunde und Pflanzenzüchtung, Munich, Germany.
4. "Problems and proposals for international certification of seed origin and seed-stand quality with particular reference to the species native to Western North America." Leo A. Isaac, Collaborator, Pacific Northwest Forest and Range Expt. Sta., Portland, Ore., U.S.A.

Session B

1. "Delineation of improvement objectives and their possible attainment."
   a. "Growth and stem form." Helge Johnsson, Director, Swedish Forest Tree Breeding Association, Ekebo, Svalöv, Sweden.
   b. "Pest resistance (diseases, insects and other agents)." Ernst J. Schreiner, In Charge, Forest Genetics Research, Northeastern Forest Expt. Sta., Upper Darby, Pa., U.S.A.
2. "The role of cytology, physiology and exotics in tree improvement."
   a. "The role of cytology in forest genetics research." Prof. P. N. Mehra, Head, Botany Department, Punjab University, Amritsar, India.
   b. "The role of physiology in forest tree improvement." Prof. Dennis Richardson, Department of Forestry, University of Aberdeen, Aberdeen, Scotland.
3. "The role of exotic species in forest tree improvement." J. M. Fielding, Forestry & Timber Bureau, Canberra, Australia.

Session C

1. "Improvement through the utilization of natural variation."
   a. "Improvement through racial selection and testing." Dr. W. Wettstein, Forstliche Bundesversuchsantalt, Schönbrunn, Vienna, Austria, and Hans Hufnagl, Director for Forestry, Landwirtschaftskammer, Linz, Austria.
   b. "Improvement through individual tree selection and testing, seed stands, and clonal seed orchards." Wolfgang Langner, Director, Institute for Forest Genetics, Schmalenbeck über Ahrensburg, Germany.
2. "Improvement through the creation of new types."
   a. "Improvement through inbreeding and intraspecific and interspecific hybridization." F. I. Righter, Chief, Division of Forest Genetics Research, Pacific Southwest Forest & Range Expt. Sta., U. S. Forest Service, Berkeley, Calif., U.S.A.
   b. "Mass production of control-pollinated seed of conifers." Prof. Sin Kyu Hyun, Department of Forestry, Seoul National University, Suwon, Korea.
   c. "Improvement through polyploidy and mutagenesis." Prof. Ake Gustafsson, Forest Research Institute, Stockholm, Sweden.

Section III. Forest Protection

Session A

Weather and Climate in Forest Protection

1. "Climate and disease epidemics." G. H. Hepting, Chief, Division of Forest Diseases Research, Southeastern Forest Expt. Sta., Asheville, N. C., U.S.A.
2. "Weather and insect epidemics." Prof. W. R. Henson, Department of Zoology, School of Forestry, Yale University, New Haven, Conn., U.S.A.
3. "Weather and fire control practices." Prof. W. E. Reifsnyder, School of Forestry, Yale University, New Haven, Conn., U.S.A.
4. "Lightning-caused forest fires." J. S. Barrows, Chief, Division of Forest Fire Research, Intermountain Forest & Range Expt. Sta., U. S. Forest Service, Missoula, Mont., U.S.A.

Session B

Forest Pathology

1. "Intercontinental spread of forest pathogens: Significance of introduced diseases."
   a. On a world basis. T. R. Peace, Chief Research Officer, Forest Research Station (Alice Holt), Forestry Commission, Wrecclesham, Surrey, England.
   b. From the European point of view. Prof. M. M. Krstic, Forest Faculty, Kneza Viseslava, Belgrade, Yugoslavia.
   c. From the Asiatic point of view. K. Imazeki, Chief, Protection Division, Government Forestry Experiment Station, Tokyo, Japan.
2. "New approaches to forest disease control."
   a. "Chemical control, including antibiotics." H. R. Offord, Chief, Division of Forest Disease Research, Pacific Southwest Forest & Range Expt. Sta., Berkeley, Calif., U.S.A.
   b. "Cultural control." Prof. G. Wellenstein, Forschutzstelle Sudwest, Freiburg, Germany.
3. "Present and potential significance of root rots in intensive forest management." H. Van Vloten, Director, Forest Experiment Station, Wageningen, Netherlands.

Session C

Forest Entomology

1. "Chemical control of forest insects."
   a. "Aerial spraying, including side effects." James J. Fettes, Head, Chemical Control Section, Forestry Biology Division, Ottawa, Canada.
   b. "New approaches, including systemics." Prof. J. A. Rudinsky, Oregon State College, Corvallis, Ore., U.S.A.
2. "Biological control of forest insects."
   a. "The role of parasites and predators." B. M. McGugan, Associate Director, Forest Biology Division, Ottawa, Canada.
   b. "New approaches." T. A. Angus, Bacteriologist, Insect Pathology Research Institute, Sault Ste. Marie, Canada.
3. "Cultural control of forest insects." A. D. Voute, Institute for Biological Field Research, Arnhem, Netherlands.

Session D

Forest Fire

1. "Forest fire control methods and practices."
   a. "Meeting protection objectives in difficult years." R. H. Luke, Fire Control Officer, New South Wales Forestry Commission, Sydney, Australia.
   b. "Aerial support of ground fire fighters." A. W. Greeley, Assistant Chief, U. S. Forest Service, Washington, D. C., U.S.A.
2. "Forest fire research."
   a. "Research in principles governing fire spread." K. Inoue, Ministry of Agriculture and Forestry, Tokyo, Japan.
   b. "Research in forest fire control." J. S. Macleod, Head, Fire Protection Section, Forestry Branch, Ottawa, Canada.

Section IV. Forest Economics

Session A

Policy and Economic Problems

1. "In the conversion of old-growth forests to managed stands."
   a. Africa. G. Gilbert, Sr. Research Officer, Institut pour l'Etude agronomique du Congo belge, Brussels, Belgium.
   b. South America. A. F. A. Lamb, Formerly Conservator, Forest Department, Port-of-Spain, Trinidad.
   c. North America. David T. Mason, Consulting Forester, Mason, Bruce & Girard, Portland, Ore., U.S.A.
   d. Asia. Burma Forest Service, Rangoon, Burma.
2. "The conversion of hardwood coppice forests to high forests." Profs. P. Cochet and P. Turpin L'Ecole Forestiére des Barres Nogent-sur-Vernisson, Loiret, France.

Session B

Supply, Demand and Marketing of Forest Products

1. "Role of timber supply and requirements analysis in formulating forest policy." Prof. J. S. Speer, University of Munich, Munich, Germany, and Prof. K. Mantel, University of Freiburg, Freiburg, Germany.
2. "Development of markets for forest products: needs and techniques." E.

Bryan Latham, Chairman, James Latham Ltd., London, England.

3. "Effect of population pressures on timber needs." Shri C. A. R. Bhadran, Chief Conservator, Indian Forest Service, Madras, India.
4. "Potentialities of tropical forest in the world's timber economy."
   a. Aubreville, Directeur, Laboratoire de Phanérogamie, Museum National d'Histoire Naturelle, Paris, France.

Session C

Institutional Arrangements for Forestry

1. "Relation of public agencies to private forestry." N. A. Osara, Director General, Finnish State Board of Forestry, Helsinki, Finland; Stanley G. Fontanna, Dean, School of Natural Resources, University of Michigan, Ann Arbor, Mich., U.S.A.
2. "Opportunities for foreign investment in forestry." D. W. Milne, Milne, Laidlow and Associates, Ltd., Toronto, Canada.
3. "Cooperatives for forest management and marketing of timber products." Gosta Olhammar, Director, National Confederation of Forest Owners Cooperative Association, Stockholm, Sweden.

Session D

How to Achieve Better Management on Small Woodlands

1. "Special problems of the small forest owner." L. I. Barrett, U. S. Forest Service, Washington, D. C., U. S. A.; S. Obata, Chief, Management Division, Government Forest Experiment Station. Tokyo, Japan.
2. "Means of promoting forestry on small woodlots." A. Langsaeter, Director, Skogdirektoratet, Oslo, Norway: H. Følund, Direktøren for Statsskovbruget, Copenhagen, Denmark.

Section V. Education

General Theme: Education in Forestry for Countries with Newly Developed Forestry Programs.

Session A

Criteria for Determining Types, Size and Scope of Programs

1. "Estimating the need for forestry staff at various levels." Alfred Kotschwar, Dean, Facultad de Ingeniería Forestal, Bogotá, Colombia.
2. "Criteria for deciding whether to develop a full program of forestry education, technician to post-graduate level." Prof. Fehim Firat, L'Université d'Istanbul, Istanbul, Turkey.
3. "Fixed versus free programs." R. Rol, Directeur, L'Ecole Nationale des Eaux et Forêts, Nancy, France; Prof. E. C. Mobbs, University College of North Wales, Bangor, No. Wales.

Session B

Developing Technical Educational Programs

1. "The ranger school." J. W. B. Sisam, Dean, Faculty of Forestry, University of Toronto, Toronto, Canada.
2. "The professional school." J. Weck, Director, Bundesforschungsanstalt für Forst & Holzwirtschaft, Reinbek bei Hamburg, Germany.
3. "Post-graduate education for world forestry." Svend O. Heiberg, Director, Graduate Studies, College of Forestry, Syracuse University, Syracuse, N. Y., U.S.A.

Session C

Enlisting Support and Participation in Forestry by Landowners and the Public

1. "Public educational programs in nations having limited experience in forestry." Yungjoon Kim, Chief, Bureau of Forestry, Seoul, Korea.
2. "Education for political and industrial leaders." Enrique Beltrán, Under Secretary Recursos Forestales y de Caza, Mexico D.F., Mexico.
3. "Education for farmers and other small woodland owners." Hitoshi Yamazaki, Director General, Forestry Agency, Tokyo, Japan.
4. "Forestry education and programs in a nation with a rapidly changing forest economy." Frank H. Kaufert, Director, School of Forestry, University of Minnesota, St. Paul, Minn., U.S.A.
5. "Forestry extension and public education in a nation having a well-developed forest economy." W. Plym Forshell, Section Chief, Kungl. Skogsstyrelsen, Stockholm, Sweden.

Section VI. Forest Products

Session A

Wood: Its Structure and Physical and Mechanical Properties

1. "Recent progress in research on wood cell wall structure." H. E. Dadswell and A. B. Wardrop, Division of Forest Products (CSIRO), Melbourne, Australia.
2. "Structure of wood as revealed by the electron microscope." Walter Liese and Wilfred A. Coté, Jr. Forstbotanisches Institut und Institut für Holzforshung, University of Munich, Munich, Germany.
3. "Anistrophy in the microscopic and submicroscopic structure of wood." Prof. R. D. Preston, Department of Botany, University of Leeds, Leeds, England.
4. "Rheology of wood." V. M. Ivanov, U.S.S.R.
5. "Nondestructive tests to evaluate the physical and mechanical properties (sonic, ultrasonic, and other methods)." R. F. S. Hearmon, Forest Products Research Laboratory, Princes Risborough, Aylesbury, England.

Session B

Wood Quality: Factors That Affect It, and Improvement Through Genetics and Silviculture

(Joint session with Section II, Forest Genetics)

1. "Development of an adequate concept of wood quality for the guidance of geneticists and forest managers." Harold L. Mitchell, Chief, Division of Timber Growth & Utilization Relations, Forest Products Laboratory, Madison, Wis., U.S.A.
2. "The effect of growth conditions on the structure and properties of wood." Prof. Gerd Hildebrandt, School of Forestry, University of Freiburg, Freiburg, Germany.
3. "Progress towards selection and breeding of trees with superior wood characteristics and method of evaluation." Prof. Bruce J. Zobel, School of Forestry, North Carolina State College, Raleigh, N. C., U.S.A.
4. "Fast, accurate microtechniques and equipment for the evaluation of wood quality in small samples." Takeshi Kano, Government Forest Experiment Station, Tokyo, Japan.
5. "The natural variability of wood as it affects selection of test material and structural applications of wood." Prof. Wolfgang Knigge, Institut für Forstbenutzung, University of Göttingen, Hannover-Munden, Germany.

Session C

Chemistry and Biochemistry of Wood

1. "Chemistry of cellulose and its derivatives." Prof. Herman Zank, Brooklyn Polytechnic Institute, Brooklyn, N. Y., U.S.A.
2. "Chemistry of lignin." Prof. Karl Freudenberg, University of Heidelberg, Heidelberg, Germany.
3. "Biochemistry of natural disintegration of wood." Prof. W. F. Nord and W. J. Schubert, Fordham University, New York, N. Y., U.S.A.
4. "Biochemistry of wood extractives." A. B. Anderson, Biochemist, Forest Products Laboratory, University of California, Berkeley, Calif., U.S.A.
5. "Chemical conversion products from wood." Edward G. Locke, Director Forest Products Laboratory, Madison, Wis., U.S.A.

Session D

Lumber Manufacture and Wood Processing

1. "Choosing the right type of sawmill to fit specific needs." Allan Jung, Söderhamn, Sweden; A. Chardin, Centre Technique Forestier Tropical, Nogent-sur-Marne, France; V. Hasek, FAO Forestry Officer, Centro de Treinamento, Santarem, Para, Brazil.
2. "Mechanization and automation of small sawmills." Milton H. Mater, President, Mater Machine Works, Corvallis, Ore., U.S.A.
3. "Automation in wood processing industries." John E. Hyler, John E. Hyler and Associates, Peoria, Ill., U.S.A.
4. "Improvements in sawing technology and new methods of cutting wood (sonic methods; thick veneer slicing; other slicing)." Bertil Thunell, Swedish Forest Products Research Laboratory, Stockholm, Sweden.

Session E

Integrated Utilization, Including Small Sized Timber and Mill Residues

1. "Improved utilization efficiency through integrated wood industries." E. Kinnunen, Director, Industry Department, Ministry for Trade and Industry, Helsinki, Finland.
2. "Use of thinnings and forest residues." E. G. Richards, Forestry Commission, London, England.
3. "The use of sawdust and other mill residue." Halvor Skjelmerud, Director, Norsk Treteknisk Institutt, Blindern, Norway.
4. "Better utilization of low-quality woods through processing research." Peter Koch, Vice-President, Champlin Box Company, Rochester, N. H., U.S.A.

5. "Use of wood and wood residues in production of fiberboard and particle board." Harry Schwartz, Forest Products Laboratories Division, Forestry Branch, Ottawa, Canada.

Session F

Wood Preservation and Protection

1. "Penetration of chemicals into wood." N. Tamblyn, Officer in Charge, Preservation Section, Division of Forest Products (CSIRO) Melbourne, Australia.
2. "New preservatives and treatment method." H. P. Sedziak, Forest Products Laboratories Division, Forestry Branch, Ottawa, Canada.
3. "Status of biology and control of marine borers." Prof. G. Becker, Bundesanstalt für Materialprüfung, Berlin, Germany.
4. "Fungus and insect problems in storage and use of wood." Prof. Robert A. Zabel, College of Forestry, Syracuse University, Syracuse, N. Y., and R. A. St. George, Entomologist, U. S. Agricultural Research Center, Beltsville, Md., U.S.A.
5. "Fireproofing of timber."

Session G

Progress in Developing New Pulp Sources

1. "Pulping broadleaf trees." D. T. Jackson and R. F. Bower, Hammermill Paper Co., Erie, Pa., U.S.A.
2. "Pulping tropical woods." L. J. Rys, Mill Manager, Cellulosa de Chihuahua, Chihuahua, Mexico.
3. "Newsprint from broadleaf woods." Joseph N. Swartz, Technical Director, Bowaters Southern Paper Corporation, Calhoun, Tenn. U.S.A.
4. "Kraft paper and paperboard from broadleaf woods." S. M. Temple, Development Division, Australian Paper Manufacturers Ltd., South Melbourne, Australia.
5. "Feasibility of small pulp mill operation." Percy R. Sandwell, Consulting Engineer, Sandwell and Co., Vancouver, Canada.

Section VII. Forest and Range Watersheds

Session A

Protection Forests

1. "Forest practices in control of avalanches, floods, and soil erosion."
   a. In the Alps. Profs. Hampel, Figala, and Praxl, Austria.
   b. In the Mediterranean Area. L. Sainz Sanguino, Subdireccion del Patrimonio, Forestal del Estado, Madrid, Spain.
   c. In Japan. Prof. S. Ogihara, Department of Forestry, Tokyo University, Tokyo, Japan.
   d. In the Himalayan Front. D. C. Kaith, Chief Conservator, Indian Forest Service, Simla, Himachal Pradesh, India.
2. "Shelterbelts."
   a. "Design." B. I. Logginov, U.S.S.R.
   b. "Crop yields." E. J. George, Silviculturist, Crops Research Division, Agricultural Research Service, Mandan, N. Dak., U.S.A.

Session B

Management for Water Production

1. "Riparian vegetation." C. H. Banks, Department of Forestry, Pretoria, Union of South Africa.
2. "Controlling forest composition." A. A. Molchanov, U.S.S.R.
3. "Effective cutting practices." Herbert C. Storey, Director, Division of Watershed Management Research, U. S. Forest Service, Washington, D. C., U.S.A.
4. "On municipal watersheds." Howard Lull, Chief, Division of Watershed Management Research, Northeastern Forest Expt. Sta., Upper Darby, Pa., U.S.A.
5. "Forestry and water supplies." Prof. L. Leyton, Department of Forestry, Oxford University, Oxford, England.

Session C

Management for Protection of Soil and Water

1. "Logging methods in relation to streamflow and erosion." Earl G. Dunford, Chief, Division of Watershed Management Research, Pacific Northwest Forest Expt. Sta., Portland, Ore., U.S.A.
2. "Grazing management practices." Kenneth W. Parker, Director, Division of Range Management Research, U. S. Forest Service, Washington, D. C., U.S.A.
3. "Grazing effect on soil stability and forest production." J. P. Challot, Conservateur, Diréction des Eaux et Forêts, Rabat, Morocco.
4. "Forest and range watersheds in a Mediterranean climate." M. Navarro Garnica, Subdireccion del Patrimonio, Forestal del Estado, Madrid, Spain.
5. "Water regulation for increased timber production." E. A. Schlaudt, Drainage Engineer, U. S. Soil Conservation Service, Spartanburg, S.C., U.S.A.

Section VIII. Forest Recreation and Wildlife

Session A

Management of Forest Lands for Recreation

1. "Techniques of managing public use of forested areas." Henry Vaux, Dean, School of Forestry, University of California, Berkeley, Calif., U.S.A.
2. "Preserving a pleasing landscape." Lars-Erik Esping, Svenska Naturskyddsforeningen, Stockholm, Sweden.
3. "Recreational values of South American forests." Lucas A. Tortorelli, Director General, Direccion General de Parques Nacionales, Buenos Aires, Argentina.
4. "Problems of recreational management of open forests in some countries of Southeast Asia." Nguyen Van Hiep, Chief, Service National de la Protection de la Nature, Saigon, Vietnam.

Session B

Wildlife Resources of Forest Lands

1. "Moral and ethical aspects of hunting and angling for sport." C. H. D. Clarke, Assistant Chief, Fish and Wildlife Branch, Ontario Department of Lands & Forests, Toronto, Canada.
2. "Ecological aspects of game control measures in African wilderness and forested areas." B. L. Mitchell, Biologist, Department of Game and Fisheries, Livingstone, Northern Rhodesia.
3. "Wildlife management and protection in U. S. forests." Lloyd W. Swift, Chief, Division of Wildlife Management, U. S. Forest Service, Washington, D. C., U.S.A.
4. "Wild game production and harvesting methods in intensively managed forests of Northern Europe." Wolfgang Koehler, Forestry Secretary, German Embassy, Washington, D. C., U.S.A.

Session C

The Administration and Use of Forested Parks, Wilderness and Natural Reserves

1. "The values and uses of wilderness: A world view." Justice William O. Douglas, U. S. Supreme Court, Washington, D. C., U.S.A.
2. "The national parks and preserves of Africa: Their significance and problems affecting their future." Colonel Mervin Cowie, Director, Royal National Parks of Kenya, Nairobi, Kenya.
3. "Natural reserves in densely populated, highly industrialized nations." Prof. Jean G. Bear, Institute of Zoology, University of Neuchatel, Neuchatel, Switzerland.
4. "People and natural reserves." Conrad L. Wirth, Director, National Park Service, Washington, D. C., U.S.A.
5. "The establishment of parks in Western Pacific nations." Tsuyoshi Tamura, Chairman, National Parks Association of Japan, Tokyo, Japan.

Section IX. Logging and Forest Operations

Session A

Planning and Management of Operations

1. "Preparation and use of logging plans." L. T. Murray, Jr., Vice-President, West Fork Timber Company, Tacoma, Wash., U.S.A.
2. "Training and safety of logging and forest workers." S. I. Sjöstedt, Board of Crown Lands and Forests, Stockholm, Sweden.
3. "Effect of mechanization on forest labor efficiency." H. J. Loycke, Technische Zentralstelle für Deutsche Forstwirtschaft, Dillingen/Donau, Germany.
4. "Social progress of forest workers." Prof. Eino Saari, Department of Forestry, University of Helsinki, Helsinki, Finland.

Session B

Planning and Management of Operations

1. "Logging in the U.S.S.R. and its prospects." G. M. Orlov, U.S.S.R.
2. "Efficient cable operations." Prof. H. Steinlin, University of Freiburg, Freiburg, Germany.
3. "Tractor skidding vs. animal skidding in tropical countries." N. S. Kaikini and A. Naidu, Conservators, Indian Forest Service, Bangalore, Mysore State, India.
4. "Prospects of debarking and chipping in the woods." Robert DeLong. St. Regis Paper Company, Tacoma, Wash., U.S.A.

5. "Equipment and methods for small trees, plantations and small holdings." Jarl Lindfors, The Central Association of Finnish Woodworking Industries, Helsinki, Finland.

Session C

Log Handling and Primary Transport

1. "Logging road location, spacing, and standards." Carl Raynor, Timberlands Manager, Georgia-Pacific Corporation, Springfield, Ore., U.S.A.
2. "Logging road construction and maintenance." Prof. E. R. Huggard, Department of Forestry, University College of North Wales, Bangor, North Wales.
3. "Loading and unloading trucks and rail cars." T. N. Busch, International Paper Company, Mobile, Ala., U.S.A.
4. "Truck vs. rail haul of forest products." M. J. LeRay, Chief, Division des Exploitations, Centre Technique Forestier Tropical, Nogent-sur-Marne, France.

Section X. Tropical Forestry

Session A

1. "The regeneration and establishment of tropical forests."
   a. "By natural regeneration." Alistair Foggie, Chief Conservator, Forest Department, Accra, Ghana.
   b. "By planting (including exotics and enrichment)." Frank H. Wadsworth, Leader, Tropical Forest Research Center, U. S. Forest Service, Rio Piedras, Puerto Rico, U.S.A.
2. "Obstacles to tropical forestry."
   a. "Lack of markets and incomplete utilization." M. N. Gallant, Formerly FAO Officer, Survey, England.
   b. 'Land tenure." Prof. W. A. Gordon, Department of Forestry, Oxford University, Oxford, England.
   c. "High management costs." M. L. Begue, Chef, Service Central des Eaux et Forêts de la France d' Outre-Mer, Paris, France.

Session B

1. "Intensive vs. extensive management of tropical forests." Prof. C. A. Donis, L'Institut Agronomique de L'Etat, Gembloux, Belgium.
2. "Shifting agriculture."
   a. "Benign and malignant aspects." Paul W. Bedard, International Cooperation Administration, Washington, D. C., U.S.A.
   b. "Case histories."
      (1) Near East. H. F. Mooney, Forest Advisor British Middle East Development Division, Addis Ababa, Ethiopia.
      (2) In the Philippines. Florencio Tamesis Nasipit Lumber Co., Manila, Philippines.
      (3) Africa. E. Madoux and G. Geortay, Institut National pour L'Etude Agronomique du Congo Belge, Yangambi, Belgian Congo.

Provisional Program Dates[1]

	DATE	MORNING	AFTERNOON
Sunday	August 28	Registration	Registration
Monday	August 29	Registration	Opening Ceremonies First Business Plenary
Tuesday	August 30	First General Session Multiple-Use	Second General Session Multiple-Use
Wednesday	August 31	Third General Session Progress in World Forestry	First Technical Session (Silviculture I Session A (Products VI Session C (Protection III Session A
Thursday	September 1	Second Technical Session (Silviculture I Session B (Logging IX Session A (Economics IV Session A	In-Congress Tours
Friday	September 2	Third Technical Session (Products VI Session A (Genetics II Session A (Watersheds VII Session A	Fourth Technical Session (Recreation VIII Session A (Tropical Forestry X Session A (Education V Session A
Saturday	September 3	Fifth Technical Session (Watersheds VII Session B (Products VI Session B (Logging IX Session B	Sixth Technical Session (Silviculture I Session C (Products VI Session D (Protection III Session C
Sunday	September 4	Free	Seventh Technical Session (Silviculture I Session D (Logging IX Session C (Watersheds VII Session C
Monday	September 5	Eighth Technical Session (Products VI Session E (Silviculture I Session F (Economics IV Session B	Ninth Technical Session (Genetics II Session B (Education V Session B (Recreation VIII Session B
Tuesday	September 6	In-Congress Tours	In-Congress Tours
Wednesday	September 7	Tenth Technical Session (Silvicultural I Session E (Protection III Session D (Recreation VIII Session C	Eleventh Technical Session (Products VI Session F (Genetics II Session C (Tropical Forestry X Session B
Thursday	September 8	Free	Second Plenary
Friday	September 9	Twelfth Technical Session (Education V Session C (Economics IV Session C (Protection III Session B	Thirteenth Technical Session (Silviculture I Session G (Products VI Session G (Economics IV Session D
Saturday	September 10	Final Plenary	

[1]This program is provisional and some minor changes may still be necessary. Authors listed will prepare lead-off papers; all may not appear in person at the Congress. Additional copies of the provisional program can be obtained from the Executive Secretary, Fifth World Forestry Congress, Room 1146, Office of International Conferences, 1776 Pennsylvania Avenue, Washington 25, D. C.

Notes and Observations

Research on Natural Areas

Natural Areas are basically important for ". . . science, research and education" as set forth in the Society's approved definition. During the past 13 years the Committee on Natural Areas has directed attention to the availability of the Society's natural area system for silvicultural and ecological studies and related research.

Individual members of the Committee have been aware of a few research projects on specific areas. However, the Committee was not aware of the extent of such research throughout the entire system. To obtain a better knowledge of the actual use of the natural areas a survey was undertaken in 1959.

The survey indicated that research was actually in progress on 29 of the 108 natural areas reporting. These are located in 15 states. There follows a brief statement indicating the type of project and sponsoring agency for each of the natural areas reporting research.

G. A. Person N. A.—Oregon
1. Growth and mortality in virgin ponderosa pine.
2. Seed production in virgin ponderosa pine.
3. Twig clipping by Albert squirrel.

Rocky Mountain Forest and Range Experiment Station.

Oak Creek Canyon N. A.—Arizona
1. Distribution of bryophytes and lichens.

Duke University.

Walnut Canyon N. A.—Arizona
1. Effect of ground moisture on tree ring growth.

MacAlester College under grant from National Science Foundation.

Indiana Summit N. A.—California
1. Insect study plot—increase or decrease in insect activity.

Pacific Southwest Forest and Range Experiment Station.

White Mountain N. A.—California
1. Dendroclimatology in bristlecone pine.

University of Arizona.

Gothic N. A.—Colorado
1. Annual summer research studies in ecology, mammalogy, ornithology and parasitology.

Rocky Mountain Biological Laboratory.

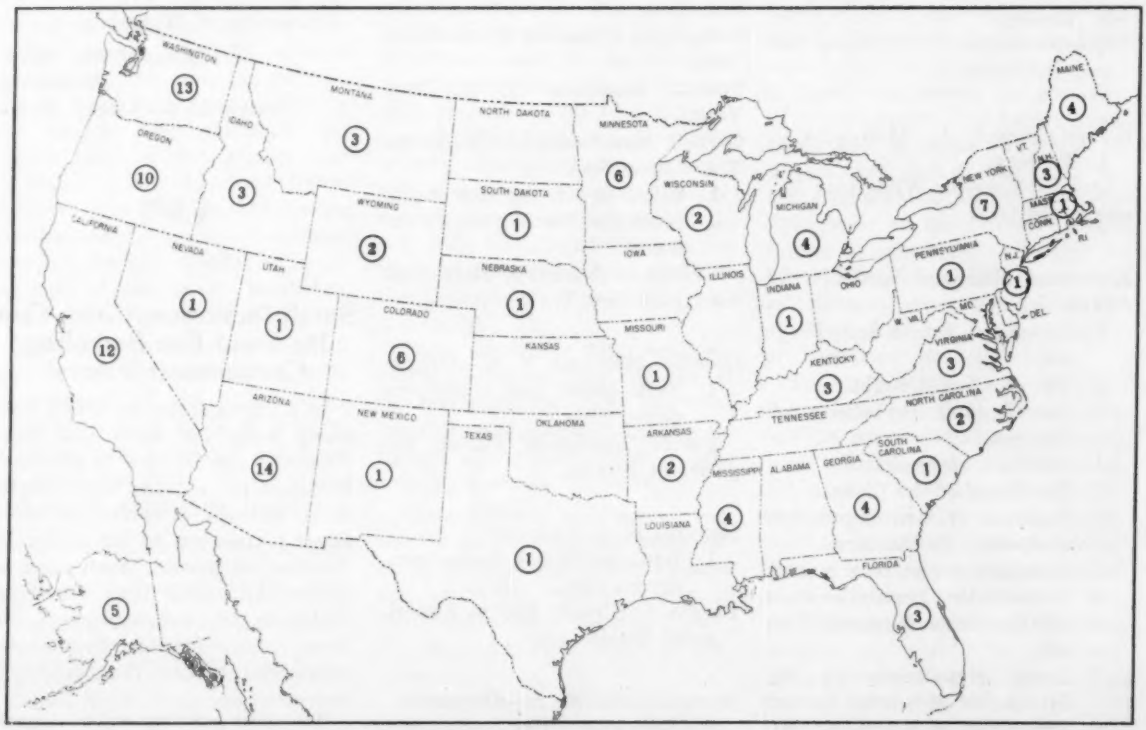


FIG. 1.—Number of SAF Natural Areas by states.

St. Marks N. A.—Florida
1. Soil fauna analyzation.
College of Forestry, State University of New York.

Canyon Creek N. A.—Idaho
1. Ecological studies.
Washington State College.

Teepee Creek N. A.—Idaho
1. Series of 25—1/5 acre silviculture plots used as a check on similar plots in adjacent commercially thinned stands.
U. S. Forest Service.

Moosehorn N. A.—Maine
1. Forest tree growth.
Bureau of Sport Fisheries and Wildlife.
2. Soil fauna analyzation.
College of Forestry, State University of New York.

Seney N. A.—Michigan
1. Soil fauna analyzation.
College of Forestry, State University of New York.

Lac La Croix N. A.—Minnesota
1. Ecology.
Quetico-Superior Wilderness Research Center.

Keeley Creek N. A.—Minnesota
1. Ecology.
Quetico-Superior Wilderness Research Center.

Hutcheson Memorial Forest N. A.—New Jersey
1. Hutcheson Forest Soils Project.
2. The effect of drought.
3. Growth and periodicity of the woods.
4. Old field succession.
5. The fungi of the forest.
6. Relation of bird population to stratum in the forest.
7. Complete forest tree census.
8. Salamander populations in the Hutcheson Memorial Forest.
9. Insect populations in the Hutcheson Memorial Forest.
10. Character of the forest humus.
11. Hickory as accumulator of rare earth elements.
12. Study of the mammals of Hutcheson Memorial Forest.
13. Study of the soil fauna of Hutcheson Memorial Forest.
Rutgers University.

Current River N. A.—Missouri
1. Study of the microflora.
University of Missouri Department of Botany.

Pack Demonstration Forest N. A.—New York
1. Selection of superior white pines for forest genetics research.
College of Forestry, State University of New York.

Huntington N. A.—New York
1. Used as a "control" on a wide variety of environmental manipulation experiments.
College of Forestry, State University of New York.

Wolf Pond N. A.—New York
Five Ponds-Wolf Pond N. A.—New York
Totten and Crossfield N. A.—New York
Plateau Mountain N. A.—New York
Cornell Mountain-Slide Mountain N.A.—New York
1. Selection of superior white pines for forest genetics research.
College of Forestry, State University of New York.

Goodlow Mountain N. A.—Oregon
1. Bark beetle risk study-ponderosa pine.
Pacific Northwest Forest Experiment Station.

Metolius N. A.—Oregon
1. Bark beetle risk study—ponderosa pine.
Pacific Northwest Forest Experiment Station.

Pringle Falls N. A.—Oregon
1. Bark beetle risk study—ponderosa pine.
2. Seedfall studies—ponderosa pine.
Pacific Northwest Forest Experiment Station.

Meeks Table N. A.—Washington
1. Analysis of soils of central Washington.
2. Effect of land management on soil stability.
3. Ecology of ponderosa pine forest range land.
Pacific Northwest Forest Experiment Station.

Wind River N. A.—Washington
1. Trends in growth and mortality in old growth Douglas-fir including density and composition of understory vegetation.
Pacific Northwest Forest Experiment Station.

Necedah N. A.—Wisconsin
1. Soil fauna analyzation.
College of Forestry, State University of New York.

Snowy Range N. A.—Wyoming
1. Ecology.
University of Wyoming.

JOHN F. SHANKLIN
Chairman,
Committee on Natural Areas

Small Increment Cores Can Be Used For Sampling Cottonwood Fibers[1]

In a recent study we found that small increment cores (5.2 mm. diameter) can be used to accurately determine average fiber length in cottonwood (*Populus deltoides* Bartr.) trees up to 30 inches in diameter. Removing small cores is faster and easier than removing wedge-shaped sections, plugs, or large cores. Average fiber-length measurements were the same from

[1]This study was conducted in cooperation with the Forest Products Laboratory, Madison, Wis.

these small cores as from large cores or wedge-shaped sections. Also, this small-core method can be used to sample wood elements of other species when the maximum length of the sampled element does not exceed 2 mm. And finally, the holes left by the small borer rapidly heal over so the tree can be used for future studies.

Wood samples for fiber-length studies have usually been obtained from standing trees by sawing a wedge-shaped section of wood from the trunk[2] or by removing cylinders of wood with plug cutters[3] or large-diameter (8 to 11 mm.) increment borers.[4] These methods are useful for sampling outer rings but are not practical for taking samples near the pith of standing trees larger than 18 inches in diameter. Small-diameter increment borers (5.2 mm. inside diameter and 40 cm. long) can be used to obtain wood samples from trees up to 30 inches in diameter.

We had some doubt whether the small-size core would provide an adequate and accurate sample of whole fibers. Because wood elements are oriented vertically in the stem and because the best sample occurs near the vertical diameter of the core, the percentage of wood in a core containing the longest wood elements decreases with a decrease in core diameter. A search of the literature revealed that apparently no one had ever actually determined how satisfactory small-core measurements would be. We wanted to find out, so we tried it.

Four small increment cores (5.2 mm. in diameter) and four large plug cores (12.7 mm. in diameter) were taken from each of 9 trees. All cores were taken 4.5 feet from the ground at 90-degree intervals; each of the plug cores was taken within an inch of an increment core. The samples used came from one annual ring of 7 of the trees and from 2 annual rings of the other 2. For each sampling method and for each tree, the corresponding samples by annual rings were combined and macerated. Two samples were taken from each maceration and the lengths of 100 uncut fibers, randomly selected from each sample, were measured with a microprojector.

Variation in mean fiber lengths between the four increment cores and the four plug cores was not statistically different for any of the 11 ring samples; although, mean fiber lengths among rings were different. Thus the four increment cores, 5.2 mm. in diameter, contained a reliable sample of fibers.

Comparisons were also made between 4 increment cores 5.2 mm. in diameter and a wedge-shaped section from a 21-year-old tree. Increment cores were taken from each corner of a 2-inch square on the surface of the trunk. Then a wedge-shaped section was removed which included the four holes left by the increment borer. From the increment cores, the sample cylinders of the 5th, 10th, 15th, and 20th rings from the pith were removed. The four cylinders from each of these rings were combined and macerated. From the wedge-shaped sample also, wood of the 5th, 10th, 15th, and 20th rings was removed from the area outlined by the increment core holes and macerated.

There were no differences between the mean fiber lengths of the increment cores and the wood from the wedge-shaped sample, although again mean fiber lengths among rings were different.

Cores 5.2 mm. in diameter can also be used to sample wood elements of other hardwoods because the length of wood elements of most hardwoods is less than 2 mm., the maximum fiber length of cottonwood.

More than 80 cottonwood trees located in Illinois, Missouri, Kentucky, and Indiana have been sampled by removing 5.2 mm. cores. The use of the smaller increment borer has greatly reduced the time and cost of sampling the fibers in these trees, and has made it possible to include trees up to 30 inches in diameter in our study.

STEPHEN G. BOYCE
Central States Forest Experiment Station, Forest Service, U. S. Department of Agriculture
and
MARGARET KAEISER
Southern Illinois University, Carbondale, Ill.

[2]Echols, R. M., and F. Mergen. How to extract large wood samples from living trees. Jour. Forestry 53: 136. Illus. 1955.

[3]Kaeiser, Margaret. Variations in fiber length of eastern cottonwood. Forest Products Lab. Report. No. 2047. 6 pp. Illus. 1956.

[4]Echols, R. M. Evaluating trees and stands from large increment cores. Proc. Soc. Amer. Foresters Meeting 145-147. Illus. 1959.

Giant Sequoia in Europe

The United States can be proud having natural living monuments such as the big tree, *Sequoia gigantea*, commonly called giant sequoia, and its brother redwood, *Sequoia sempervirens*. They grow only in particular areas on the Pacific Coast, reaching 300 feet in height. Their age is incredible. Some of them started their growth at the birth of Christ, and are still living and growing today.

These trees attract the attention of nature lovers in different countries, and in some countries attempts are being made to acclimatize sequoias. In the December 1958 issue of the Soviet Russian forestry magazine, *Lesnoje Choziajstvo*, P. I. Molotkov gives information about the growth of our sequoia in the southern region of European Russia.

The first attempt to introduce this species into Russia was made in 1858, when seed of giant sequoia were planted in a nursery of Nikitinskij Botanical Garden in Crimea, peninsula of the Black Sea. In 1859-1860 this botanical garden received some seedlings of giant sequoia from France, and the following year this garden distributed the plants for planting along the coast of the Black Sea and in the Caucasus.

This species has become remarkably well established in the Crimea.

Concerning the latitude of this area, it is on approximately the same parallel (45 degrees) as is Portland, Oregon. In the Nikitinskij Botanical Garden these trees being 60 years old, are over 85 feet in height and more then 39 inches in diameter.

In Samarkand, South Russia, giant sequoia of the same age reach up to 105 feet. In the Caucasus these trees were planted on wet sites along the coast of the Black Sea and are not doing as well.

Since 1951 attempts are being made to grow giant sequoia in the Carpathian Mountain region. The climate of that region is as follows: mean annual temperature is between 37 degrees F. and 50 degrees F.; absolute minimum temperature is between —2 degrees F. and —22 degrees F.; maximum temperature between 86 degrees F. and 103 degrees F.; annual precipitation ranges from 21 to 53 inches.

In the United States the province of giant sequoia is between the 36th and 39th degrees north latitude. Altitudinal distribution along the Sierra Nevada Mountains is from 5,000 to 8,000 feet. In this area annual precipitation, which varies with altitude and from year to year, ranges from 18 to 60 inches. The best growth occurs where the annual precipitation is between 45 and 60 inches. The temperature varies from —12 degrees F. to 100 degrees F. The best growth is achieved where the minimum temperature is —5 degrees F. and the maximum is 94 degrees F.[1]

The seed of giant sequoia were ordered and planted in the nursery for several years, however, without success. Only in 1957 have several seedlings been established. At the same time it was learned that a few trees of giant sequoia are already growing in the Rochovskij Forest, on the slope of the Russian Carpathians. The area where these trees grow has an elevation of approximately 2,000 feet above sea level. A steep slope of the mountains breaks up and makes a flat terrace-like area. Behind this flat a steep slope rises again. The terrain is of paleozoic origin. The ground surface shows sandstones and mica. On this flat grow in a cluster four giant sequoias. They can be recognized from a distance by their reddish brown bark and long conical crown. Live limbs begin from 8 to 13 feet above the ground; dead limbs from 6 to 8 feet above the ground.

One tree is 29.5 feet in height and 8.8 inches in diameter. Another is 36 feet in height and 11.3 inches in diameter. The other two are smaller and their height does not exceed 19.7 feet; the diameter is not over 5 to 6.5 inches. One tree has recently been cut because dead. Examination of stump showed that this tree had annual rings 0.39 inch wide and that it was 24 years old. The stump had evidence of butt-rot disease, which appeared to be the cause of its death. However, examination of the site revealed that butt-rot was, most likely, not the main cause of the tree's death. Water running from the upper slope onto this flat area made it excessively moist, making this area nearly swampy. Vegetation growing around this group of sequoias also indicates excessive moisture. This site condition perhaps weakened the tree and the butt-rot killed it.

Trees in that area were established in the following way. About 20 years ago there was a temporary forest nursery. In 1933 the nurseryman received some giant sequoia seed and planted them in this nursery. A few seed sprouted, and the trees grew. For the first few years these plants were protected against winter frost by covering. Later this nursery was abandoned, and the giant sequoias continued to grow in the nursery-bed without care.

This case is quite interesting in that it shows that the giant sequoia is a considerably hardy tree, and once it becomes established it can grow without special care in a region having comparatively rough conditions, even where absolute minimum temperature as low as —22 degrees F.

JOHN KUPRIONIS
Louisiana Polytechnic Institute, Ruston

[1]G. H. Schubert. Silvical characteristics of giant sequoia. USDA California Forest and Range Expt. Sta. Technical Paper No. 20.

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Washington 6, D. C.

A Modified-Knife Cone Cutter for Douglas-Fir Seed Studies

Research on Douglas-fir seed requires accurate counts of filled and insect-damaged seed inside sample cones. Counts are made on the cut surface of a cone sliced in half longitudinally. The surface must be smooth in order to leave the individual seeds in place and clearly visible. Cone cutters with the conventional paper-cutter type action are now in wide use for quick approximations of filled seed content. However, sectioning of cones with these cutters leaves torn surfaces and displaces the seed beyond use for research. To meet specifications in research, Charles A. Sherman, of the Weyerhaeuser Engineering Department, built the modified-knife cone cutter which is described here.[1]

The cone cutter was built with the design illustrated in Figure 1. A key feature is the thin-bladed butcher knife with a 1½-inch steel arm welded on the tip to give an offset of 90° from the back of the blade. This arm pivots on a fulcrum raised 3 inches above the cutting block that receives the cone. In use, as the knife handle is pushed down, the blade has a forward and downward slicing action. The straight blade edge meets the cone along its entire length, holding it from slipping as it is sliced. Other cone cutters of different design have been reported. The Osborne knife[2] which gives a rough field cut is a handy "pocket" tool.

An English model[3] has a semicircular blade which would give a "rolling" cut. The modified-knife cone cutter with raised fulcrum provides high leverage and slicing action of a thin blade that achieves the desired smooth cone sections with one quick easy stroke.

Materials for building the cone cutter are readily available locally. The parts and their assembly are shown in Figure 1. The knife is a Lamson with a thin chrome steel blade having a V-ground edge as described by Peterson.[4] A chrome steel rod was used for welding the offset arm. This is bolted snugly between the fulcrum members, which are of strap iron. The blade guide which assures a straight stroke of the knife without bowing is also of strap iron. Both the fulcrum members and blade guide are welded to a channel iron frame which in turn is secured to the wooden base by screws. The cutting block is seated in the channel iron. It has a central V-groove ¼ inch deep to seat the cone for cutting. A sawn slit in the bottom of the groove allows the blade edge to remain free when in lowered position. The assembly of parts gives a sturdy cone cutter, well-adapted for heavy service.

The modified-knife cone cutter was tested by continuous use at the Weyerhaeuser Forestry Research Center during the 1958 and 1959 cone seasons. To maintain the ease of cutting it is important to keep the knife blade clean and sharp. Mechanics' cleaning cream, used in

[1]Acknowledgment is given for constructive suggestions by Floyd B. Robinson of the Centralia office.

[2]Hopkins, Donald R. The Osborne tree cone cutting knife. Jour. Forestry 54: 534. 1956.

[3]Buszewicz, G. and Holmes, C. D. Preliminary trials of a quick method for estimating the seed content of cones. Forest Research for March 1956. Forestry Commission Report (London). pp. 99-106. 1956.

[4]Peterson, Harold L. American knives. Charles Scribner's Sons, New York. 178. pp. Illus. 1958.

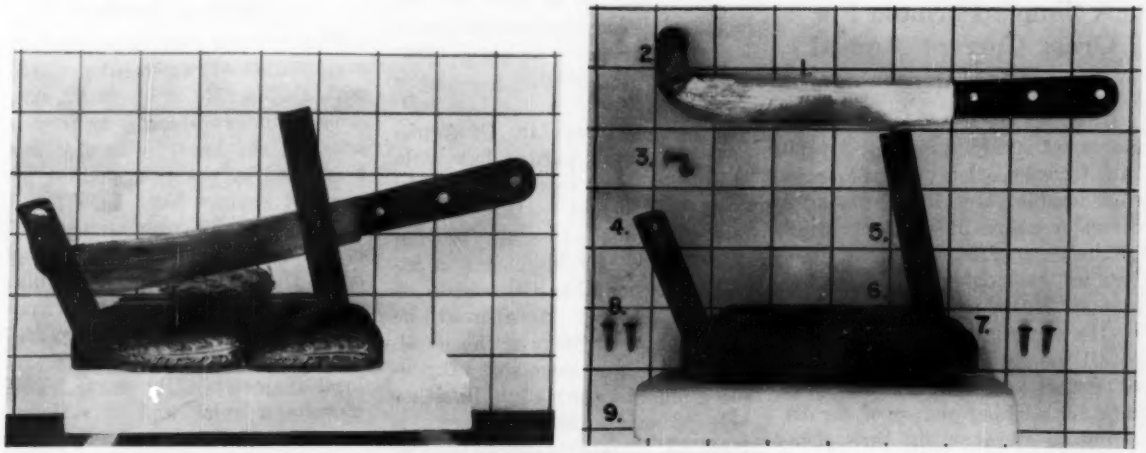

FIG. 1.—Modified-knife cone cutter, on 2-inch grid background. *Left*: Sectioning Douglas-fir cones. *Right*: Disassembled to show parts, with dimensions in inches:

1. Butcher knife with thin chrome tool steel blade 10×1½×3/32, and hardwood handle 5¼×1¼×¾
2. Welded chrome steel offset arm 1½×1×3/32
3. Pivot bolt and acorn nut ⅝×¼
4. Strap iron fulcrum members, two each 5×1×⅛
5. Strap iron blade guide (bent U-shape) 15×1×⅛
6. Douglas-fir V-grooved cutting block 6×2½×1½
7. Channel iron frame, 9×3×1½
8. Flat head No. 12 wood screws (four)
9. Douglas-fir base 12×6×2

cone research to remove pitch from hands, works well for frequent cleaning of the blade. The ease of removing the blade by a turn of the pivot nut favors periodic sharpening. For safety of operation one hand should always be kept on the knife handle when placing a cone on the cutting block. This renders the cone cutter no more hazardous than an office paper cutter. The Douglas-fir cones cut ranged in length from 1 to 5 inches and from green to a dry condition. In addition, green cones of ponderosa pine, Pacific silver fir, grand fir, and western hemlock were cut. Throughout, the cone sections showed the smooth surface with seeds in place which is essential for research needs. For 1960, 75 modified-knife cone cutters were built[5] for use in cone testing at buying stations serving Weyerhaeuser Tree Farms.

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[5]These cone cutters were built by Coolidge & Sons. Centralia, Wash.

A Simple Formula For Gross Current Annual Increment

Although the use of gross annual increment is rare in current American forestry, the term possesses considerable value in expressing a direct measure of some accuracy in the determination of site quality in reasonably well stocked stands. If this value is determined by the sum total of the increments of all the trees upon the acre—or other unit area adopted—it affords a rather striking picture of the distribution of increment throughout the stand. This enables the forester to understand the classes of trees that are growing well and those that should either be removed or freed from excessive competition.

German yield tables commonly give gross increment together with "mortality" — thinnings, while American tables give only net increment plus death loss expressed only in tree numbers and never by volume that is lost, so that it becomes impossible to compute the gross increment without the use of distinctly rough estimates. The American studies of increment also are limited to "merchantable" stands and the primary use of board feet as the major unit of volume. This unit is very crude as a rule and its use requires the consideration of ingrowth.

A pattern of increment in cubic feet for a managed stand computed for the entire stem, showing gross growth at the present time, would be very useful to the forest manager and would constitute a sound biological measure of stand growth involving entire tree stems. Such an approach to the matter of forest increment seems never to have been used here in the United States. Net growth ascertained from permanent sample plots or by temporary yield table plots whipped into order by statistical means has been the standard method—a poor and expensive one.

Many years ago, the old Schneider formula in which p stands for growth percent, n for the number of years required to grow the last inch, and D for the diameter inside bark at breast height: $p = \frac{400}{nD}$ was decidedly popular. Of course growth percent per se has little significance and in order to apply the figure derived by this formula the volume of the tree must be computed. If stand increment is involved rather than increment of individual trees there must be either a full coverage of the stand, tree by tree, or some sort of sampling must be resorted to. In either case no small number of trees is involved. This takes time as Graves[1] pointed out some 50 years ago, although it must be noted that he was considering a complete study of young stands of mixed hardwoods.

[1]Graves, H. S. Forest mensuration. John Wiley and Sons, New York. pp. 309-314. 1910.

The Schneider formula went out of fashion —probably because it gave increment only indirectly and also because Hanzlik and others pointed out that the formula worked better if the value 400 was somewhat modified, an idea that rather spoiled the simple formula in its original form.

In recent years a modification of this old formula appears to have cropped up occasionally under the name of Schneiderlein formula. Information on its origin and degree of use seems vague, and apparently it has never appeared in print. Since it is very simple and workable and gives a rough value for increment in cubic feet for an entire tree stem, it seems worth while to call it to the attention of foresters. The Schneiderlein formula is as follows:

$$I = \frac{D \times H \times W}{100} \text{ or } I = \frac{D \times H}{RI \times 100}$$

where I—annual increment in cubic feet
D—diameter breast height inside bark
H—height in feet
W—width of the last complete ring (in inches)
RI—rings per inch (based upon the latest period of uniform growth)

This formula permits rapid field computation of increment per tree with a slide rule or on paper, and crude values can readily be formulated in the head. Where it has been used in practice, shallow increment borings have been taken to secure recent ring widths and to get bark thickness at the same time. Diameter outside bark is taken with a diameter tape. Tree height is taken where readily feasible and is otherwise read from a local diameter-height curve. This permits a quick and easy determination of the annual increment of a tree which, in turn, means that the gross annual increment per acre can be ascertained more readily than by other methods.

In fact, gross increment has never been widely used here in America although it is commonly used in Europe. The probable reason is

that mortality is virtually nil where thinnings are a standard means of forest management. In this country mortality means that the tree is lost to the forest user. The standard determination of the more significant net increment has been through permanent sample plots. This method not only requires a long time for determination of increment but is one that seems to possess a remarkable capacity for inviting major and minor catastrophies to the selected bits of forest. Direct determination of gross increment of course is far more simple; the practical difficulty in application is the determination of mortality. The current unsatisfactory methods of handling gross and net increment are shown by Meyer's[2] method of gaging volume losses as indicated by the reductions in number-of-trees-per-acre in yield tables.

Thus it appears that there exists a very real use for a simple formula such as the Schneiderlein in simplifying the determination of gross current annual increment.

This oddly simple affair is probably a descendant of the old Schneider formula. As far as the writer is able to determine its derivation is as follows:

It is clear that the last year's increment of a tree bole is this year's volume minus last year's volume. This is readily expressed mathematically as follows, using the following symbols in addition to those already used above:

R—radius (inches)

F—form factor ("breast high form factor")

Subscript C—refers to the current year (ring growth complete)

Subscript P—refers to the previous year

Under the circumstances we find:
$I=\pi R^2_C \times H_C \times F_C - \pi R^2_P \times H_P \times F_C$

This formula, of the perfectionist type, contains distinctly absurd elements. Nobody is going to measure height with sufficient accuracy (except on small, fast growing saplings) to come at all close to the terms H_C and H_P. Form factors fall in a similar category, for nobody knows the form factor of a standing tree nor has the slightest understanding of whether it changes with a passing year. As a result the formula may just as well be rounded off to read as follows:

$I=\pi R^2_C \times H \times F - \pi R^2_P \times H \times F$

This simplifies to:

$I=\pi HF\ (R^2_C - R^2_P)$

and: $I=\pi HF\ (R_C+R_P)\ (R_C-R_P)$

but R_C+R_P amounts to diameter to all intents and purposes (D) and R_C-R_P is the width of the last ring (W) so the formula becomes.

$I-\pi HFWD.$

Both W and D are in inches, H is in feet, and F is virtually unknown. But if we multiply HWD by π, divide by 144 to change $W \times D$ to square feet, and guess at F as .462 —which happens to be the average form factor for pine in north Germany—we arrive at the convenient and simple formula: $I = \frac{DWH}{100}$.

In practice, the last rings often tend to be about the same width for a number of years and it is easier to count off the number in the last inch or fraction thereof and use the rings-per-inch value (RI) very readily. So, the writer prefers the form: $I = \frac{DH}{100\,RI}$.

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[2]Meyer, W. H. Yield of even-aged stands of Sitka spruce and western hemlock. U. S. Dept. Agric. Tech. Bul. 554. 1937.

Points of View

Is Timber Marking A Professional Job?

It is a fact that much of the marking for harvest and stand improvement in *managed* forests is being done by nonforesters. (I am not considering the great number of lump-sum and other sales where there is no management.) Timber marking is an important professional responsibility and should not be left to nonprofessional people even though they may be "trained." The analogy can be made that while practical nurses carry out the doctor's orders, take temperatures and give shots, they do not make diagnoses and perform operations.

It is only fair to observe that forest managers, whether public or private, often do not have the funds to hire professional personnel to mark timber. This makes it necessary to choose nonprofessionals and train them to select trees to cut, kill, or leave. Often these men are the ones that get the work done in the woods. This is one reason for the steady demand for simple guides and rules-of-thumb for marking timber. This simplification can sometimes be done in a meaningful way, but I think it is important to realize that it has definite limits in the practice of intensive silviculture. Some simple marking jobs for extensive silviculture may not require professional ability, or perhaps the costs of employing a forester cannot be justified by the anticipated returns from the forest. These things will have to be determined for each case.

Nevertheless, we must answer the question, is timber marking a professional job? Except for the simplest cases the decision concerning what to do with a tree involves consideration of many biological and economic variables. Not only must the forester consider the tree he is marking or leaving but he must also consider the long-term effects of what he does on other trees, on the site, and on future regeneration. In many cases he must also consider the effect of his decisions on other uses of the forest besides timber production. Timber marking may not always be as important as a medical diagnosis, but it can be fully as complex if all pertinent factors are considered. Also, from a *professional standpoint* it is important to the forester that he understand why as well as how he marks as he does. Good forestry practice is an art based on a sound groundwork of scientific principles. It is the country's loss that more professional foresters cannot be put in the woods.

LEON S. MINCKLER
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Education in Forest Fire Science

The recent articles in Points of View regarding education in forest fire science[1] prompt me to tell of current developments in this field by the School of Forestry at Montana State University.

This University, located in Missoula, Mont., is the center of forest fire activities for the Northern Rocky Mountain area. Located here is the Northern Forest Fire Laboratory of the U. S. Forest Service, the Fire Control Office for Region I of the U. S. Forest Service, the Smokejumper Base, the office of the Montana state forester, and the headquarters for the Blackfoot Forest Protective Association. Not only is Missoula the center of forest fire control activity for the Northern Rocky Mountain area, but it is also the place where forest fire research work is to be concentrated for western Canada and Alaska. Several fire research projects for Alaska are already under way at the Northern Fire Laboratory. Some graduates from the School of Forestry at Montana State University are finding employment in fire control work in Canada and Alaska.

A program of graduate study has been set up in the School of Forestry where students are doing research work in forest fire science. Two Master of Science in Forestry degrees have been granted to date in this field, and there are four candidates for such degrees at present. The Northern Forest Fire Laboratory provides excellent opportunities for these graduates to obtain data and to perform experiments. These experiments are under the general direction of the research forester, who is engaged in carrying on forest fire research in Montana as a member of the staff of the Montana Forest and Conservation Experiment Station.

The combination of forestry as background training along with the facilities of the Fire Laboratory provide an excellent basis for eventually understanding some of the problems of wild fire behavior and the control of such fires. In addition, much work needs to be done in this region with the classification of forest fuels. Such a classification is possible only through the combined efforts of foresters working along with other specialists in the field of fire science.

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School of Forestry, Montana State University, Missoula

[1]Reifsnyder, William E. Forest fire control and forestry education. Jour. Forestry 57:582-586. 1959.
Herrick, A. M. Forest fire research and education in the Southeast. Jour. Forestry 57:929. 1959.

Book Reviews

Alaska in Transition

By George W. Rogers. 384 pp. Illus. The Johns Hopkins Press, Baltimore, Md. 1960. $7.

As it focuses a good deal of attention on the part forestry will play in the transition of Southeast Alaska, this book should be of interest to foresters. The author, George Rogers, has been a resident of this subregion of Alaska for 14 years. He has served as member and head of the Interior Department's Alaska Field Committee and as economic adviser to two territorial governors, one of them Frank Heintzleman, former regional forester for Alaska. Although Rogers' specialty is economics and public administration, it is evident that he understands something of scientific forestry and thoroughly approves Forest Service methods of management.

After an introduction to the region done as only a longtime resident could do it, the author takes up the natural resources of Southeast Alaska rather briefly, and merely as an outline of what is involved. These include forests, fisheries, minerals, fur, wildlife, agriculture, and hydroelectric power. About a third of the book is devoted to the region's human resources and the desperate plight of the Indians caused by the waning fisheries resource. The Indian has always been a fisherman and does not readily take to logging. The three chapters devoted to the people of Southeast Alaska; their use of natural resources under the supervision of federal agencies; the stateside fishing interests and the resource departments of the new state are fascinating reading.

In a chapter on Managing the Region's Resources the author contrasts the methods of obtaining a sustained yield of forest products with what he terms "The Fisheries Failure." He points out that the forest resource has been kept intact until the economic climate was right for development. In the meantime surveys were brought up to date, the research base broadened, and pulp interests kept continually informed. The allowable cut based on a sustained yield has been computed and plans made to use all of it. The log export policy which prevents shipment of unmanufactured wood products outside the state assures the development of year-round wood-using industries in Alaska.

Just the opposite was the case with fisheries, according to the author. It was not until 1924 that legislation was provided for the protection of salmon. By that time the average annual exploitation had long since passed the resource's sustained yield level and many of the original runs had been destroyed. There had been no time to undertake the necessary research and plan management ahead of intensive utilization. The management philosophy has been based upon the interests of nonresident investors rather than on local factors. The essential difference between the two federal programs, forestry and fisheries, is that the one has been oriented chiefly to the region and the other chiefly to interests outside it.

The study was sponsored by the Arctic Institute of North America and Resources for the Future, Inc. It is part of a broader study of Alaska in transition.

R. F. Taylor
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(formerly forester-in-charge, Alaska Forest Research Center)

Experimental Design and Analysis in Forest Research

By J. N. R. Jeffers. 172 pp. Illus. Almquist and Wiksell, Stockholm, Sweden. 1960. Sw. kr. 30.

The Permanent Committee of the International Union of Forest Research Organizations endorsed the publication of this book. The purpose was to make "available an account of some modern methods of design and analysis."

To write such a book the author, who is of the Forestry Commission, Alice Holt Research Station, Farnham, had a problem in choosing how to present the subject to forest research workers in particular and to foresters in general. This demands compromise as thorough understanding requires a fuller knowledge of mathematics than the usual forester possesses. It is unlikely there is any single best answer for all foresters.

His approach has been intuitive rather than rigorous. This will make his book more attractive to those who tend to get lost in formula development and derivation. For this audience he has done well with a difficult and complex subject. In itself, it is doubtfully adequate for the needs of forest research. To the extent that it arouses interest and increases understanding, however, and it should do both, it is a useful addition to the library of any forest research organization.

Some mention is made of the assumption on which the techniques are based. The cautions that should be evident, when assumptions are not met, are weakened by remarks that infer that such failures may be of little consequence. A clearer statement describing the effects of

failure without judging their importance would have been more truly helpful.

This book should be regarded as an introduction to the required concepts rather than a manual of how to use the techniques. It is recommended reading for the beginner and for those others who seek a relatively simple nonmathematical treatment. It is likely this book will help a substantial portion of current forest research workers to understand the procedures described. It may connect their experience with standard statistical procedures and so enable them to use these techniques with more ease and confidence. They should then be better able to understand those texts which do provide truly adequate description.

It is unfortunate the author used so few references, especially in relation to the individual topics. A fuller listing by chapters would have made it easier for the reader to find supplemental discussion of the more complex situation which we meet so often. It would also guide the reader who wanted to know more about the specific procedure.

It should be noted that "A small number of additional copies will be available for sale" and that copies in French and German may be printed.

In conclusion we who work in the field should thank Jeffers and the Union for a well done service to forest research.

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A Year in Paradise

By Floyd Schmoe. 235 pp. Illus. Harper and Brothers, New York. 1959. $4.50.

The varied interests and inspirational qualities of Mount Rainier National Park, particularly the Paradise Valley area, are portrayed in delightful and readable fashion in this book. Mr. Schmoe was the first year-round park naturalist employed in Mount Rainier National Park, as well as one of the pioneer naturalists of the National Park Service. Before achieving that position he served briefly as caretaker of Paradise Inn, mountain guide, and park ranger. He and his wife, Ruth, went to this region as a young couple. Their experiences in this beautiful mountain area during the various seasons serve as the basis of the book.

However, *A Year in Paradise* is more than a mere recording of experiences and adventures. It contains a great deal of material relative to the natural history of this region — its wildflowers, forests, animal life, and geological significance. The area's human history is also given emphasis and a number of the more dramatic places about "The Mountain" are mentioned. Since one of the major interests of Mount Rainier National Park is the great mountain and its glaciers, the summit climb is also featured.

Among the illustrations are a number of sketches by the author. Combined with Mr. Schmoe's intimate knowledge of this area is his ability as a writer. Anyone interested in the western outdoors, particularly the Cascades of the Pacific Northwest, will find considerable enjoyment in reading his book.

C. FRANK BROCKMAN
University of Washington, Seattle

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American Universities and Colleges

Edited by Mary Irwin. 8th ed. 1212 pp. American Council on Education, Washington, D. C. 1960. $13.

A catalog of college catalogs, this eighth edition of *American Universities and Colleges* describes more than 1,000 accredited institutions of higher education and provides brief accounts of some 2,000 professional schools accredited by national professional associations.

The contents are in three parts. The first, a book in itself, contains eight chapters on education in the United States, one of which "Accreditation to Assure Quality in Higher Education," could be read with profit by every forester concerned with forestry training. There is an interesting chapter on "The Foreign Student in the United States."

Professional education is the subject of the second part; it has specially written articles on 24 individual fields, from agriculture to veterinary medicine. Forestry is included.

The institutional exhibits are in part three. Under each state is listed factual and descriptive information about each accredited university and college.

Considerable revision has gone into this edition (the first was published in 1932). It is *the* definitive reference work on American higher education.

HENRY CLEPPER

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The Natural Thing

By Pieter W. Fosburgh. 255 pp. The Macmillan Company, New York. 1959. $4.75.

Now that nearly everybody is writing a book on conservation or natural resources, usually in a studious vein, it is intriguing to find a work in this category that seems to have been written mainly for fun. Pete Fosburgh's *The Natural Thing* is uninhibited, somewhat uneven in its organization and will probably be considered unscientific; but it is a vigorous, refreshing, and highly personal account of one man's experience with conservation problems within an individual state. Written by a former editor of *The Conservationist*, house organ of the New York State Conservation Department, it contains a number of pieces composed for the magazine, and reprinted here (or, as most of them are, rewritten), along with a number which are original with the volume.

The "chapters," which vary

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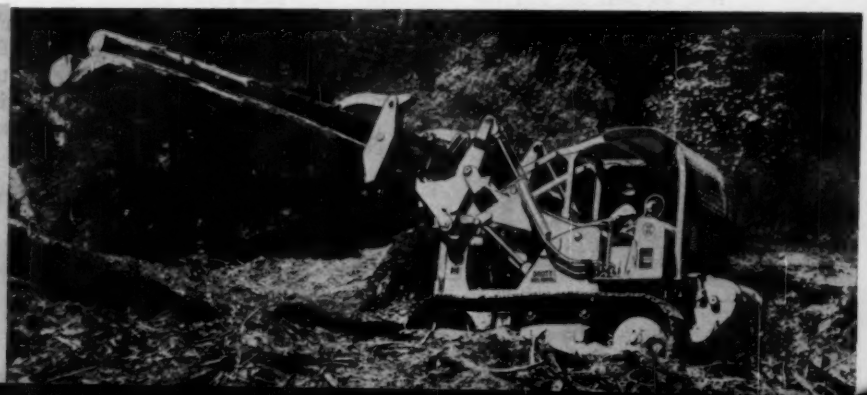

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from two and three-page vignettes of the Adirondack scene, to well-rounded essays on land management policy, are grouped under a half dozen section headings, but without any real continuity. The book jumps about from hither to yon, touching briefly on such unrelated titles as "Ginseng," "Farm Ponds," "Panther," "Man as Predator," and "Stocking the Moon."

Fosburgh, in his present capacity, is responsible to no bureau, no foundation, no editor, no boss, and writes as he pleases; yet, unlike most free-lancers, he bears the marks of ten years' working association with the professionals. This, in itself, gives the work a degree of authenticity to balance its frequently whimsical approach.

The author learned about conservation the hard way, as a landowner, logger, director of one of the large Adirondack clubs, hunter and bushwhacker—all these against a cosmopolitan background which included an undergraduate career at Yale, assignment as foreign correspondent, and naval aviation in World War II. He drifted into the Conservation Department's public relations establishment after the war practically by accident, and was not long in becoming editor of the new-fledged publication. Under his editorship, the magazine took on a professional tone, together with an originality that put it near the top of its class. In the early 1950's, he engineered a debate on Forest Preserve policy in its pages which focused statewide attention on the periodical and brought down the wrath of those who thought they saw the integrity of the Forest Preserve threatened. Department officials backed him up, nevertheless, so that he and the magazine continued to flourish.

Under a changed administration, Fosburgh became acutely unhappy and in June, 1956, made a dramatic exit from the department by filing his resignation on the front page of the *New York Times*, complete with a vitriolic blast at the Conservation Commissioner of that day, with whom he had been at odds (among other things) over the latter's attempts to introduce advertising matter in *The Conservationist* (*The Conservationist* still carries no advertising). These varied facets of his career are reflected in one way or another throughout the book.

Leaving aside its entertainment value, which is consistently high, the most substantial parts of the book are at the beginning and the end: a group of essays on submarginal farm lands and what it takes to live on them; and a thoughtful presentation, in the last chapter, of the author's ideas regarding the Forest Preserve. The most documentary single pieces are "The Big Boom," "Camp 3," "The Great Storm of 1950," and "Fire in the Cold River Blowdown."

In "The Debate on The Forest Preserve" the author traces the history and development of the Preserve and of the "Adirondack Park," punctures a few misconceptions, presents the opposing viewpoints on the "forever wild" philosophy, and ends with a plea for a new look at state policy. In particular, he makes a case for *zoning*, under which a substantial part of the Forest Preserve (outside of what he considers true wilderness areas) would become subject to a relaxation of the rigid constitutional prohibitions against timber cutting, in the interest of a better regional economy and improved wildlife habitat. But he admits that public opinion is mostly on the other side.

As a good example of the Fosburghian style, I would quote perforce from the chapter on "Rain": "On the afternoon of July 22, 1945, Mr. Atwater stepped to the door of his sawmill, took a quick look at the skies over Rensselaer County, and announced that it was going to rain. It did . . . it rained between twelve and fourteen inches in about three hours."

E. W. LITTLEFIELD
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Publications of Interest

Fifty years of wood research which brought about prefabricated houses, laminated wood, and new paper pulping processes are summarized in a booklet on the Forest Products Laboratory at Madison, Wis., issued by the U. S. Department of Agriculture.

The booklet entitled *50 Years of Service Through Wood Research* gives history and highlights of the work of this Forest Service Laboratory, which was the first and for many years the only laboratory organized exclusively for conducting research on wood and its utilization.

Copies may be obtained from the Forest Service, U. S. Department of Agriculture, Washington 25, D. C., or from the Forest Products Laboratory, North Walnut Street, Madison, Wis.

• • •

How can a rural area use the resources from its small privately owned woodlands to generate more local industry, more jobs, put more dollars in circulation and improve its forests? This is the theme of a new 28-page booklet entitled *Forest Industry Opportunities in Rural Development*, issued by the U. S. Department of Agriculture (Agri. Info. Bul. 222).

The booklet is well illustrated with documentary photographs of forest culture, harvesting, and wood-using industries in action. It discusses procedures to be followed in the establishment of 15 different small wood-using industries suited to areas near supplies of the lower grades and poorer species of timber.

Single copies may be obtained free from the Office of Information, U. S. Department of Agriculture, Washington 25, D. C., or they may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., for 25 cents.

Current Literature

Compiled by LOIS MCALLISTER, *Assistant Librarian, State University College of Forestry at Syracuse University*
Range Management Section Compiled by NELLIE G. LARSON, *Library, U. S. Department of Agriculture*

General

A Detailed Analysis of Research in the U. S. Department of Agriculture. By the USDA Agric. Research Serv. 51 pp. 1960. Available from Office of Information, U. S. Department of Agriculture, Washington 25, D. C.

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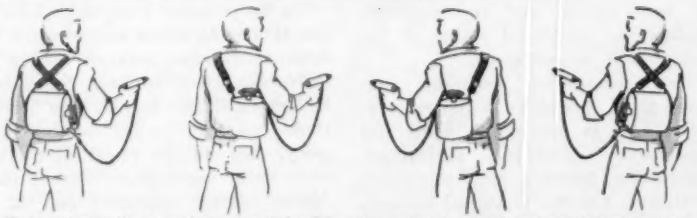

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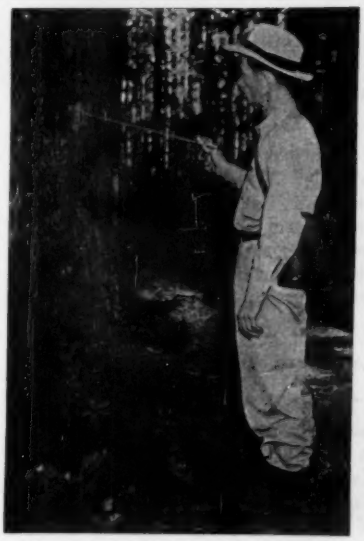

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Coming Events

Ozark Section

The summer meeting of the Ozark Section will be held at Salem, Mo., June 2-4, 1960. Float trips on Current and Jacks Fork Rivers are planned for June 2; field trips on June 3; and dedication of Licking Nursery as George O. White Forest Tree Nursery on June 4.

Kentucky-Tennessee Section

The summer meeting of the Kentucky-Tennessee Section will be held at the La Citadelle Motel, Hazard, Ky., June 10-11, 1960. A field trip is planned on June 10 to the University of Kentucky's Robinson Forest.

Northeastern Forest Tree Improvement Conference

The eighth NEFTIC meetings will be held on the campus of Yale University in New Haven, Conn., August 18-19. Dormitory facilities of the University will be available for NEF TIC members.

Upper Mississippi Valley Section

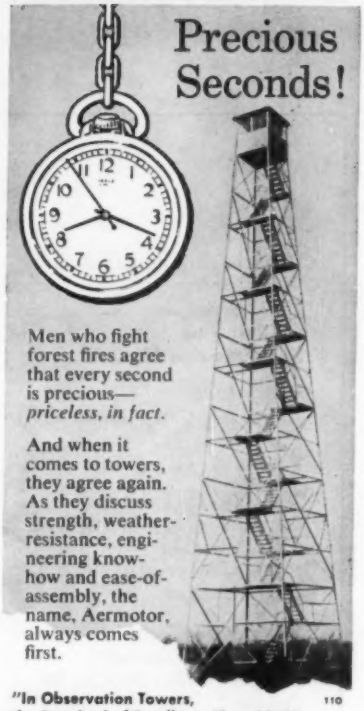
The summer meeting of the Upper Mississippi Valley Section will be held in Duluth, Minn., August 18-20, 1960. On the 19th the meeting will consist of tours and discussions in connection with the operation of the St. Lawrence Seaway and harbor facilities at the Duluth terminus. On the 20th there will be some optional woods tours arranged to visit the Cloquet Forest Research Center, University of Minnesota; the Northwest Paper Company's Forest Nursery; part of the Superior National Forest, and/or other local forestry projects of interest.

Canadian Institute of Forestry

The 1960 annual meeting of the Canadian Institute of Forestry will be held at the Chateau Frontenac, Quebec City, Canada, October 24-27, 1960.

Society of American Foresters

The sixtieth anniversary meeting of the Society of American Foresters will be held at the Sheraton-Park Hotel, Washington, D. C., November 13-16, 1960.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Oregon State College Forestry Curriculum Examined

Ernest Wohletz, dean of the University of Idaho College of Forestry, and Henry Clepper, SAF executive secretary, represented the Society of American Foresters during an evaluation of Oregon State College at Corvallis, conducted by the Northwest Association of Secondary and Higher Schools, April 19-23. The purpose of the examination was to determine whether the accredited status of the College will be continued.

The accreditation committee consisted of 31 specialists in general education and in specialized fields and professions, including agriculture, engineering, forestry, home economics, pharmacy, and the biological sciences. This was a periodic routine examination; neither the accredited status of the College as a whole nor of the forestry curriculum was in question.

Wohletz and Clepper represented the SAF Committee for the Advancement of Forestry Education of which Frank H. Kaufert, of the University of Minnesota is chairman. Dean of the OSC School of Forestry is W. F. McCulloch.

Columbia River Section Holds Successful Annual Meeting

The annual meeting of the Columbia River Section was held April 22-23 in Roseburg, Ore.

"Forestry Today and Tomorrow" was the subject of the technical session, which was opened by Martin L. Syverson, Section Chairman. T. J. Starker was moderator.

On the program were M. J. Lauridsen, timber valuation engineer for the Internal Revenue Service; George H. Schroeder, chief forester for Crown Zellerbach Corp.; and B. Sam Taylor, timber manager for Elk Lumber Company. Also on the panel were Sherman Feiss, consulting forester; Hans Milius, timber operator; and R. F. Keniston of Oregon State College School of Forestry.

The annual dinner, preceded by a social hour, was held in the Umpqua Hotel. Jack B. Hogan was master of ceremonies. In attendance were 360 members, their ladies, and guests.

At the business session, chairman Martin L. Syverson presided. Reports were made by James B. Corlett, vice chairman; Murl W. Storms, secretary;

and William A. Davies, membership chairman. Society affairs were discussed by President C. A. Connaughton and Henry Clepper, executive secretary.

A discussion of professional responsibility was conducted under the leadership of Dan D. Robinson. The keynote speaker on this subject was Dan E. Bulfer. At the termination of the discussion the members adopted the resolution published below.

At the final session, W. D. Hagenstein made a report on current legislation affecting forestry. John Bell, chairman of the Section Committee on Registration of Foresters, made a report. W. K. Ferrell reported for the Section committee appointed to develop a handbook on watershed management.

A Resolution Relating to Professional Responsibility By Columbia River Section Roseburg, Oregon, April 23, 1960

The members of the Columbia River Section of the Society of American Foresters are concerned that the Society, by remaining publicly aloof from many of the forest policy issues of the day, does not fully meet all of its objectives as stated in Article II of the Constitution.

Therefore the Section requests the Council and the Society at large to develop and adopt fair and effective procedures for the annual review, discussion and establishment of policy on the important forestry issues of the day and for taking action to carry out adopted policy.

The Section specifically suggests:

1. Development of a policy section in the Society Bylaws patterned after Article VIII of the Bylaws of the Columbia River Section as illustrated in attachment.
2. Review of existing policy statements, cancelling, modifying and reaffirming as needed.
3. Publication of existing policy annually in JOURNAL OF FORESTRY and at appropriate times through media of dissemination to the general public.
4. Designation of forest policy department in JOURNAL OF FORESTRY.
5. Assignment of responsibility for action.

SUGGESTED POLICY SECTION For Bylaws of Society of American Foresters

The Society accepts its obligation and responsibility to determine and express the Society's policy in all matters pertaining to professional forestry and shall take action to do so. Responsibility for taking such action rests with the Council, which at its discretion may appoint a committee to advise it on forest policy. The nature of the action to be taken by the Society shall be determined by the membership in the manner here described.

Proposals to be considered for Society action may originate: (1) From Society members individually, through the Sections, or at a meeting of the Society; (2) From the Council (independently or at the suggestion of a policy committee; and (3) From the Council via the Executive Secretary. Using these proposals as a basis, the Council will develop an annual program of policy matters and submit the items to the Sections during the meeting season for study, discussion and development of policy. Emergency issues arising subsequent to the formulation of the program may be submitted as they arise.

The Sections will make sure that members are fully informed and that there is full debate of issues under discussion and that decisions are reached by secret ballot. Each Section shall report the position it has taken on each such policy matter at the Joint Council-Section representative meeting held in connection with and prior to the next annual meeting of the Society. The Council shall go into executive session immediately following its joint meeting with Section representatives for the purpose of developing and adopting policy statements for the Society as indicated based upon the reported positions of the several Sections. The Council shall in turn report the Section policy positions and its action to develop and adopt Society policy statements therefrom at the Society Affairs session of said annual meeting.

Depending on how important, urgent, or controversial an issue is, the Council is authorized to exercise its discretion as to which of the following methods it uses in determining the attitude of the Society: (1) on the basis of the collective judgment of the Council members; (2) on the basis of voting conducted by the Sections; or (3) on the basis of a secret ballot referendum of voting members of the Society. The Society's policy shall be determined by the majority of those voting in any of the methods listed above, except that any action of the

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Council to establish the Society's policy on a particular matter without benefit of a secret ballot referendum of the entire voting membership of the Society shall be subject to such a referendum vote upon petition of one hundred and fifty or more voting members from three or more officially recognized Sections.

A report of the adoption of Society forest policies, whether by referenda or otherwise, shall be provided to all Society members. At its discretion, the Council may give additional publicity to policies.

Southern California Section Holds Spring Meeting

The Southern California Section held a most successful spring meeting April 1-2 when 101 members and guests assembled in San Bernardino.

The theme of the afternoon program "A Critical Look at Our Watershed Management Concepts and Practices" was aptly carried out by keynoter Anselmo Lewis, Angeles National Forest, and panel moderator Ted Silverwood, president of the Redlands—Highland Soil Conservation District, and a member of the State Soil Conservation Commission. Panel members were William Putnam, Depart of Geology, UCLA; Ed Phillips, Department of Botany, Pomona College; and William Ferrell, engineer of the Los Angeles County Flood Control District.

Guest speaker at the evening banquet was Frank Moore, editor of the *Redlands Daily Facts*. Mr. Moore spoke on the forester and his relation to the public and to events that shape public forest policy. A special event of the evening was the presentation to Ezra Miller of the American Motors Conservation Award for his many years of conservation and reforestation work in Los Angeles County. William Mendenhall made the presentation on behalf of American Motors.

Special guest at both the afternoon and evening sessions was Society President Charles A. Connaughton. President Connaughton first spoke on Society Affairs, and then on the forester's obligations in multiple-use land management.

The ladies had a sight-seeing-shopping tour during the day, and on the second day of the meeting joined members on a multiple-use tour of the San Bernardino Mountains.

Southwestern Section Holds Spring Meeting in Tucson

The spring meeting of the Southwestern Section was held in Tucson, Ariz., April 15 and 16 with headquarters in the Pioneer Hotel.

A business session was held the first morning, with chairman Robert A. Blaser presiding. The secretary and treasurer's report was given by Jay H. Cravens. C. A. Merker, vice chairman, reported on membership. Henry Clepper, SAF executive secretary, discussed Society affairs.

"Recreation and Forestry" was the subject of the technical session. Among the programmed speakers were John O. Cook, whose topic was "Recreation in National Park Areas." Yale Weinstein discussed "Recreation and Private Industry." Fred H. Kennedy, regional forester, reported on "Recreation Development in the National Forests." Paul A. Krause's paper dealt with "Recreation on Indian Lands." Other speakers represented Pima County, the Arizona State Parks Board, and the State Game and Fish Commission.

Gordon L. Hammon presided at the technical session and served as banquet toastmaster also. The featured speaker was Hon. Don Hummel, mayor of Tucson. About 90 members and their ladies attended the dinner.

On the morning of the second day the members went on a field trip to view recreational facilities in the Santa Catalina Mountains on the Coronado National Forest. Norman P. Weeden, forest supervisor, and his staff guided the tour.

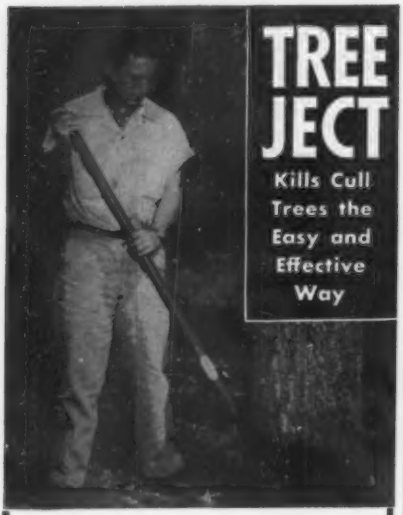
Northern California Section Officers Elected

New officers for the Northern California Section for 1960-1961 have been announced as follows:

Chairman—Wesley Spinney, U. S. Forest Service, Eureka.

Vice Chairman—Henry K. Trobitz, Simpson Redwood Co., Arcata.

Treasurer—Paul Casamajor, School of Forestry, University of California, Berkeley.



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Dues Deadline June 30

Members whose 1960 dues are not paid by June 30 will be declared in bad standing. They will no longer receive copies of the JOURNAL OF FORESTRY or be eligible as a candidate for office. Such members already have received a letter and three dues-memoranda. Pay your 1960 dues now so you will not be declared in bad standing.

E. P. Stebbing (1870-1960)

Edward Percy Stebbing, M.S., an Honorary Member of the Society of American Foresters, died March 21 at his home, Romden Castle, Smarden, Kent, England.

Born in 1870, Professor Stebbing was educated in forestry and forest entomology in England. He was appointed assistant conservator of forests in the Indian Forest Service in 1893, and served in various forestry posts in India until 1909.

In 1910 he was appointed lecturer and in 1920 head of the Forestry Department, University of Edinburgh, Scotland, where he remained until his retirement, with frequent leaves for military service in World War I and for travel and consulting work in forestry throughout the world.

He was a prolific writer, not only on forestry subjects, but on big game hunting, natural history, sports, soil erosion, and exploration. He was editor of the *Indian Forester* (1903-1907), and the first editor of Indian Forest Service publications (1907-1909).

Professor Stebbing was decorated by several foreign governments, and was a medalist of the Royal Society of Arts. One of Britain's most distinguished foresters, he exercised a great influence on British forest administration and research.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of April are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of June 1960.

Communications from the voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Alaska Section

Affiliate Grade

Scott, J. W., Fire Control Officer, Bureau of Land Mgmt., Anchorage, Alaska.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Archibald, W. M. O'Hare, J. T.

Junior Grade

Engel, J. E., R. F. D. 3, Cassons Neck, Cambridge, Md. (Reinstatement).

Appalachian Section

Member Grade

Johnson, C. M., Forester, International Paper Co., Lilesville, N. C. Univ. Mich., BSF, 1956 (Junior 1956).

Kearse, C. M., Box 161, Olar, S. C. (Junior 1953).

Stanley, W. C., Service Forester, Va. Div. of Forestry, Gloucester, Va. W. Va. Univ., BSF, 1954 (Junior 1954).

Stubbs, J., 5½ Gibbes St., Charleston, S. C. (Junior 1953).

Affiliate Grade

Dean, E. H., Supv., Poles & Piling, Georgetown, S. C.

Hutto, H. L., Forest Tech., International Paper Co., Georgetown, S. C.

O'Hara, R. R., Partner, O'Hara & Smith, Georgetown, S. C.

Perry, J. D., Forest Tech., International Paper Co., Marion, S. C.

Smith, P. E., Field Rep., O'Hara & Smith, Georgetown, S. C.

Central Rocky Mountain Section

Junior Grade

Douglas, J. F., Forest Supv., USFS, Pueblo, Colo. (Reinstatement).

Hester, D. A., Forester, USFS, Denver, Colo. (Reinstatement).

Walters, W. W., Staff Asst., USDA, Sheridan, Wyo. (Reinstatement).

Member Grade

Range, J. E., 919 So. Claussen, Grand Island, Neb. (5OR57).

Central States Section

Student Grade

PURDUE UNIVERSITY

Hedges, W. L.

Member Grade

Hunter, C. K., City Forester, City of Geneva, Geneva, Ill. Purdue Univ., BSF, 1949 (Junior 1956).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Franks, W. R. (Reinstatement).

Ullmann, D. T.

Junior Grade

Maus, C. D., Asst. State Forester, Ore. State Board of Forestry, Salem, Ore. (Reinstatement).

Peacock, C. E., Dist. Ranger, USFS, Lakeview, Ore. (Reinstatement).

Wallace, W. B., P. O. Box 502, Cathlamet, Wash. (Reinstatement).

Yedlick, T. R., Asst. Forester, J. Neils Lbr. Co., Glenwood, Wash. Univ. Wash., BSF, 1948.

Member Grade

Davies, G. R., Timber Mgmt., Asst., USFS, New Pine Creek, Ore. Univ. Calif., BSF, 1954, MF, 1959 (Junior 1954).

Doty, O. H., Forester, USDA, Waldport, Ore. Ore. State, BSF, 1954 (Junior 1954).

Fessel, W. C., Asst. Dist. Ranger, USFS, Cave Junction, Ore. State Univ. N. Y., BSF, 1954 (Junior 1954).

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Hootman, W. D., Consulting Forester, Self-Employed, Coos Bay, Ore. (Junior 1954).
Jones, H. B., Forester, Mara Chemical Co., Portland, Ore. Univ. Mich., BSF, 1956, Ore. State, MS, 1958 (Junior 1956).
Luthy, R. M., Resident Forester, Publishers Paper Co., Oregon City, Ore. Ore. State, BSF, 1951 (Junior 1956).
Mook, D. G., Timber Mgmt. Asst., USDA, Unity, Ore. State Univ. N. Y., BSF, 1954 (Junior 1954).
Nixon, R., Highway Eng., USFS, Oakridge, Ore. (Junior 1953).
Seymour, L. H., Consulting Forester, Tree Farm Mgmt. Service, Inc., Eugene, Ore. (Reinstatement).
Spray, R. H., Forester, USFS, Corvallis, Ore. Ore. State, BSF, 1955 (Junior 1955).
Stiles, W. C., Forest Eng., Evans Products Co., North Bend, Ore. (Junior 1953).

Affiliate Grade

Carlson, L. E., Forester, Bur. of Land Mgmt., Salem, Ore. (Reinstatement).
Cobb, W. O., Forester, USDA, Burns, Ore.
Dean, H. R., Fire Control Officer, USFS, Detroit, Ore.
Gunnerod, K., Asst. Forester, International Paper Co., Gardiner, Ore.
Hurt, T. C., Log Buyer, Coos Bay Pulp Corp., Empire, Ore.
Inman, J. V., Dist. Asst., USFS,, Gardiner, Ore.
Marsh, N. T., Tbr. Inventory Supv., State Tax Comm., Salem, Ore.
Miller, H., Forest Eng., Columbia River Paper Co., Portland, Ore.
Rarey, B. W., Dist. Asst., USFS, Mill City, Ore.
Smith, C. S., Asst. Forester, Willamette Valley Lbr. Co., Dallas, Ore.
Watson, M. W., Forestry Aid, USDA, John Day, Ore.

Associate Grade

Jones, A. H., General Mgr., City Water & Light Dept., McMinnville, Ore.

Gulf States Section

Junior Grade

Pallin, D. A., Tech. Forester, George Banzhaf & Co., Milwaukee, Wis. Univ. Mich., BSF, 1958.

Student Eligible for Automatic Advancement

LOUISIANA STATE UNIVERSITY

Weaver, B. D.

Member Grade

Burkhalter, H. D., Director, T. L. James & Co., Inc., Ruston, La. La. Poly Tech., BSF, 1935 (Af49J56).
Champagne, E. P., Dist. Forester, Texas Forest Service, Kirbyville, Texas La. State, BSF, 1950 (Junior 1956).

Affiliate Grade

Cook, C. D., Forester, Southern Pine Lbr. Co., Lufkin, Texas.
Daniel, J. S., Director, Southern Pine Lbr. Co., Diboll, Texas.

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Dungan, J. L. Reeb, M. C.
O'Donnell, J. F. Taubman, J. H.

Junior Grade

Shelden, L. C., Unit Forester, U. S. Dept. of Interior, Spokane, Wash. (Reinstatement).

Affiliate Grade

Scott, J. C., Logging Foreman, Potlatch Forests, Inc., Headquarters, Idaho.

Intermountain Section

Student Grade

UTAH STATE UNIVERSITY

Beutler, B. L.

Junior Grade

Butler, J. J., Forester, USFS, Mountain Home, Idaho (Reinstatement).

New England Section

Junior Grade

Simpson, C. J., Consultant, Heath Survey Consultants, Inc., Andover, Mass. Univ. N. H., BSF, 1959.

Member Grade

Christie, A. H., Service Forester, Park & Forest Comm., Newton, Conn. (Reinstatement).
Hollingsworth, S., President, Annett Lbr. Co., Inc., Jaffrey, N. H. Yale Univ., MF, 1955 (Junior 1955).
Mawson, J. C., Instructor of Forestry, Univ. of Mass., Amherst, Mass. Univ. Maine, BSF, 1956, Duke Univ., MF, 1958 (Junior 1956).

Affiliate Grade

Archibald, F. J., Forestry Aid, USFS, Conway, N. H.

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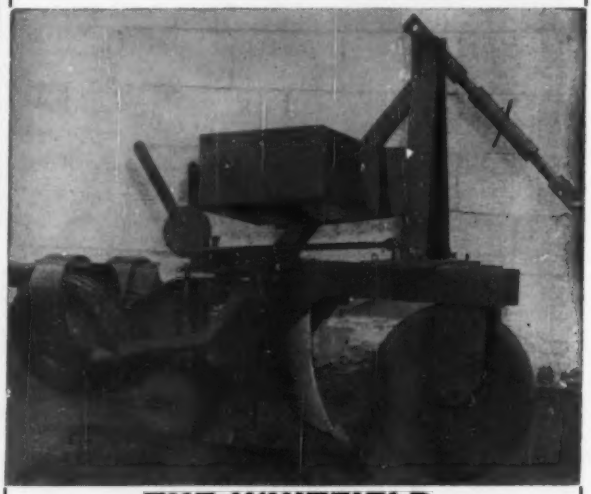

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Chadbourne, P. H., Mgr., P. H. Chadbourne & Co., Bethel, Maine.
Cote, J. L., Forest Ranger, State of Conn., Cobalt, Conn.
Duval, R. L., Dist. Forester, Scott Paper Co., Jackman Station, Maine.
Heath, C. N., Dist. Forester, New Hampshire Forestry Dept., Concord, N. H.

Northern California Section

Junior Grade

Falkner, E. H., Tbr. Mgmt. Asst., USFS, Milford, Calif. Mich. College Mining & Tech., BSF, 1955.
Raibley, M. W., Forester, Cheney Grant Lbr. Co., Pondosa, Calif. Univ. Calif., BSF, 1949.

Member Grade

Acker, H. R., 2135 Dartmouth Drive, Eureka, Calif. (Junior 1953).
Agrons, B. Z., Rockport Star Route, Mendocino County, Westport, Calif. (Junior 1953).
Austin, R. J., USFS, North Fork, Calif. Junior 1953).
Chilman, K. C., Asst. Dist. Ranger, USFS, Mammoth Lakes, Calif. Purdue Univ., BSF, 1956, Univ. Mich., MF, 1959 (Junior 1956).
David, R. R., USFS, Callahan, Calif. (Junior 1953).
Davis, J. B., 111 Wilkie Drive, Walnut Creek, Calif. (Junior 1953).
Estes, K. M., USFS, Hayfork, Calif. (Junior 1953).
Gladish, E. N., 2221 34th Ave., Sacramento, Calif. (Junior 1953).
Hansen, J. H., Univ. of Calif., School of Forestry, Berkeley, Calif. (Junior 1953).
Hanson, O. J., USFS, Somesbar, Calif. (Junior 1952).
Hastings, L. C., Paul Bunyan Lbr. Co., Reading, Calif. (Af46J51R55).
Hubbard, W. G., 5024 J Parkway, Sacramento, Calif. (49R54).
Hubbell, R. J., Asst. Forest Tech., Calif. Div. of Forestry, Fort Bragg, Calif. Mich. State, BSF, 1954 (Junior 1954).
Mosher, H. L., 355 North Pine St., Susanville, Calif. (Junior 1953).
Muir, R. J., Forest Asst., Southern Pacific Land Co., Weaverville, Calif. Univ. Calif., BSF, 1953 (Junior 1953).
Nicholson, J. E., 2575 Ronald Loop, Placerville, Calif. (Junior 1953).
Oyung, F., Placerville, Calif. (Junior 1953).
Pease, W. E., 6616 Grant Ave., Carmichael, Calif. (Junior 1953).
Petersen, E. J., Range & Forestry Officer, Bur. of Land Mgmt., Sacramento, Calif. Iowa State, BSF, 1949 (Junior 1956).
Smithberger, T. J., USFS, Sawyers Bar, Calif. (Junior 1953).
Wade, D. N., P. O. Box 16, Caspar, Calif. (Junior 1953).
Wright, J. R., USFS, Paskenta, Calif. (Junior 1953).
Wykoff, N. E., USFS, Berry Creek, Calif. (Junior 1953).

Affiliate Grade

Ritchey, J. R., Asst. Forest Tech., Calif. State Div. of Forestry, Davis, Calif.

Northern Rocky Mountain Section

Student Grade

MONTANA STATE UNIVERSITY

Johnson, P. S. Mosier, C. W.
Patterson, J. B.

Junior Grade

Driesbach, P. K., Forester, USFS, Missoula, Mont. (Reinstatement).

Ozark Section

Student Grade

UNIVERSITY OF MISSOURI

Sams, J. P.

Junior Grade

Agar, A. J., Unit Forester, International Paper Co., Pine Bluff, Ark. (Affiliate 40R48).

Affiliate Grade

Click, W. G., Forester, Chemical Corps., U. S. Army, Pine Bluff, Ark.
Cunningham, J. E., Forest Tech., International Paper Co., Malvern, Ark.
Paty, E., Forest Tech., International Paper Co., Sheridan, Ark.
Qualls, D. D., Forester, USDA, Glenwood, Ark.

Associate Grade

Clippert, G. H., President, Southern Pulpwood Co., Inc., Camden, Ark.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Tolstrup, E. M.

Junior Grade

Gallison, G. D., Park Naturalist, Nat'l. Park Service, Port Angeles, Wash. Univ. Calif., BSF, 1954.
Hayes, P. L., Mgmt. Forester, Dept of Natural Resources, Chehalis, Wash. (Reinstatement).
Pless, D. W., Forest Mgmt. Forester, Dept. of Natural Resources, Sultan, Wash. Univ. Wash., BSF, 1959.
Steiger, R. T., Forester, USFS, Glacier, Wash. Univ. N. H., BSF, 1959.

Affiliate Grade

Bigger, D. E., Asst. Dist. Administrator, Dept. of Natural Resources, Sultan, Wash.
Hart, F. C., Asst. Dist. Administrator, Dept. of Natural Resources, North Bend, Wash.
Jensen, R. N., Asst. Dist. Administrator, Dept. of Natural Resources, Sedro-Woolley, Wash.
Lindley, E. E., Dist. Administrator, Dept. of Natural Resources, Sultan, Wash.
McLure, J. R., Mgmt. Forester, Dept. of Natural Resources, Sedro-Woolley, Wash.
Thomason, H. F., Fire Control Officer, USDA, Port Angeles, Wash.

Associate Grade

Fosnaugh, O. J., Farm Forester, Dept. of Natural Resources, Deming, Wash.
Kverno, N. B., Research Biologist, Dept. of Interior, Olympia, Wash.

Southeastern Section

Student Grade

UNIVERSITY OF GEORGIA

Becton, H. E. Cooper, C. C.
Brown, G. K. Higginbotham, P. R.
Rhyne, J. A.

Junior Grade

Allen, G. J., Cons. Forester, Union Bag-

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Close, B. W., Forest Operations Mgr., The Buckeye Cellulose Corp., Foley, Fla. Univ. Fla., BSF, 1949.
Dasher, H. B., Forest Supv., Union Bag-Camp Paper Corp., Savannah, Ga. (Affiliate 1947).
Heiges, D. W., Forester, Newton Wright & Hardin Lbr. Co., Forsyth, Ga. (Reinstatement).

Member Grade

Campbell, W. A., Owens-Illinois of the Bahamas, Jacksonville, Fla. (Reinstatement).
Webb, J. E., Asst. Dist. Ranger, USFS, Wilma, Fla. N. C. State, BSF, 1956 (Junior 1956).

Affiliate Grade

Pierce, K., Forestry Aide, USFS, Birmingham, Ala.

Southern California Section

Member Grade

Bauer, D. R., Forest Supv., USFS, San Bernardino, Calif. (Reinstatement).
Britton, L. R., Staff Officer, San Bernardino Nat'l. Forest, San Bernardino, Calif. (49R55).
Crouch, C. H., Resource Staff Officer, USFS, Santa Barbara, Calif. (Junior 1953).
Williams, H. J., Dist. Ranger, Los Padres Nat'l. Forest, Frazier Park, Calif. (Junior 1953).

Southwestern Section

Junior Grade

Von der Lippe, G. M., Chief Park Ranger, Nat'l. Park Service, Santa Fe, N. Mex. Mich. State, BSF, 1951.

Member Grade

Jones, M. F., Forest Ranger, USFS, Grants, N. Mex. (Reinstatement).
Latimore, R. E., Head Wildlife Mgmt. Section, USFS, Albuquerque, N. Mex. (Reinstatement).
Loring, T. J., Forester, Gila Nat'l. Forest, Silver City, N. Mex. (Junior 1953).

Affiliate Grade

Freeman, D. R., Forester, USFS, Overgaard, Ariz.
Schulle, B. W., Forester, USFS, Fredonia, Ariz.

Upper Mississippi Valley Section

Student Grade

IOWA STATE UNIVERSITY

Bulman, J. S. Christopher, P. A.

Junior Grade

Kitzrow, H. J., Asst. Regional Forester, Minn. Forest Service, St. Paul, Minn. (Reinstatement).
Marshall, G. D., Forester, Allied Chemical Corp., Dubuque, Iowa. Iowa State, BSF, 1950.

Student Eligible for Automatic Advancement

IOWA STATE UNIVERSITY

Hambrock, R. L.

Member Grade

Olson, R. H., Staff Inventory Asst., Minn. Div. of Forestry, Grand Rapids, Minn. Mont. State, BSF, 1956 (Junior 1956).

Affiliate Grade

Hage, F. D., Asst. Area Forester, Minn. Forest Service, Hibbing, Minn.
Holden, I. W., Asst. Area Forester, Dept. of Cons., Cloquet, Minn.
Homstad, E. A., Dist. Forest Ranger, Minn. Div. of Forestry, Cromwell, Minn.
Leerssen, O. F., Forest Ranger, Minn. Div. of Forestry, Cloquet, Minn. (Reinstatement).
Makela, J. G., Area Forester, Minn. Div. of Forestry, Tower, Minn.
Olson, O. W., Area Forester, Dept. of Cons., Cloquet, Minn.
Simons, E. W., Asst. Area Forester, Div. of Forestry, Bemidji, Minn.
Tarbell, R. C., Dist. Ranger, Minn. Div. of Forestry, Cotton, Minn.
Wagoner, H. E., Tbr. Appraiser, Minn. Dept. of Cons. Tower, Minn.
Woollett, N. W., Asst. Area Forester, Minn. Dept. of Cons., Mooselake, Minn.

Washington Section

Junior Grade

Ward, R. M., Forester, Nat'l. Park Service, Washington, D. C. Ore. State, BSF, 1950.

Member Grade

Schultz, E. W., Tbr. Mgmt. & Staff Asst., USDA, Washington, D. C. (Reinstatement).
Wood, J. H., Asst. Director, USFS, Washington, D. C. Univ. Wash., BSF, 1933 (Junior 1956).

Affiliate Grade

DeGroat, R. E., Staff Cons. Officer, U. S. Air Force, Washington, D. C.

Wisconsin-Michigan Section

Junior Grade

Henriksen, W. A., Forester, Cliffs Dow Chemical Co., Marquette, Mich. Mich. State, BSF, 1951.
Leonardi, E. L., Cons. Officer, State of Michigan, Big Bay, Mich. Univ. Mich., BSF, 1947.
Orcutt, J. P., Dist. Ranger, USFS, Ontonagon, Mich. (Reinstatement).

Affiliate Grade

Beyer, P. G., Forestry Aide, Kimberly-Clark of Michigan, Inc., Iron Mountain, Mich.
Litts, B. V., Pulpwood Buyer, Kimberly-Clark of Michigan, Inc., Iron Mountain, Mich.

No Section

Corresponding Grade

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Forestry News

Fifth World Forestry Congress To Feature 200 Speakers From 37 Nations

A professional force of 200 speakers from 37 nations will take the lead in exploring every aspect of forestry—from surveying virgin timber in Alaska to discussing new markets for wood products in Africa—during the Fifth World Forestry Congress at Seattle, Wash., August 29-September 10.

"Each of the speakers has had extensive forestry experience and each is an expert on the specific topic assigned to him," according to Dr. Hardy L. Shirley, Dean of the College of Forestry at Syracuse University and chairman of the Congress Program Committee.

Nearly 2,000 foresters from 90 nations are expected to attend the Congress, the first the United States has hosted and the first to be held in the Western Hemisphere.

Preparations for the Congress are being made, in collaboration with the Food and Agriculture Organization of the United Nations, by an organizing committee of 44 forestry experts appointed by the Secretary of State with Forest Service Chief Richard E. McArdle as chairman.

The two-week program of the Congress will explore in detail 10 broad subject areas: Silviculture and Management, Genetics, Protection, Economics and Policy, Education, Products, Forest and Range Watersheds, Recreation and Wildlife, Operations, and Tropical Forestry.

General sessions of the Congress will review progress in forestry throughout the world as of 1960 and will direct special attention to the problems and advantages of multiple use of forest land.

The program will feature such speakers as G. G. Takle, former inspector general (chief forester) of forestry for India, speaking on multiple use practices and problems in the forests of India and Asia; N. G. Hiep, chief forester of Viet Nam, talking on recreation management in forests of Southeast Asia; and M. K. Shawki of the Sudan, reporting on forestry progress in the Near East.

Others of the 200 featured speakers include Eric Hagberg, in charge of forest survey for Sweden and an authority on problems of estimating forest resources; D. Heinskijk, an expert on inventorying tropical forests who is working with the U. N. Food and Agriculture Organization in Bra-

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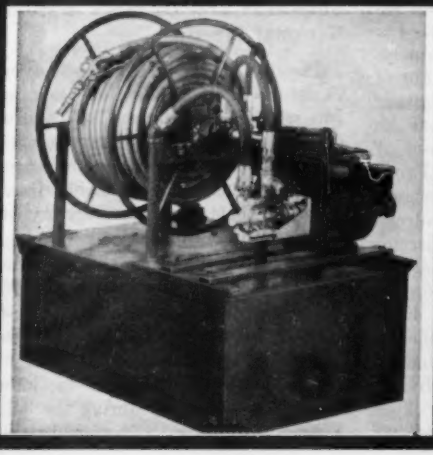

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Seventh National Watershed Congress

Some 300 persons attended the 7th National Watershed Congress held in Washington, D. C., April 18-20. The Congress was launched by a special commemorative ceremony for the new 4-cent Water Conservation postage stamp. Postmaster General Arthur E. Summerfield presided at the ceremony.

The 3-day Congress, sponsored annually by more than 20 industrial, agricultural, and conservation organizations, was devoted to discussion of a wide variety of subjects bearing upon water resources with major emphasis on protection and management of upstream watersheds by expediting and broadening local programs. One day was devoted to group conferences with officials from federal agencies.

Director Maurice H. Stans of the Bureau of the Budget was keynote speaker at the annual banquet held on the 19th.

19th Southern Forestry Conference Held

A call for new emphasis on the cooperative approach to southern forestry, for greater teamwork in coordinating efforts and activities all along the line, from grass roots to top management, was sounded by the 19th Southern Forestry Conference, sponsored by the Forest Farmers Association and held at Jacksonville, Fla., in March.

Nearly 400 timber owners, managers, and processors joined top-ranking forestry and timber experts and regional leaders in coming to grips with the challenging questions posed by the theme of the conference: "Cooperation is Essential to Successful Forest Farming." They honored the South's state foresters, focal points of the cooperative forestry efforts, and applauded presentation of the Forest Farmer Award for 1960 to Dr. R. E. McArdle, chief of the U. S. Forest Service, for outstanding contributions to the advance of southern forestry.

Earlier, as one of the principal speakers, Dr. McArdle set the conference pace by reviewing gains achieved in the South through cooperative effort, spearheaded by the state foresters. "They have performed a tremendous job," he declared, "in helping timberland owners help themselves."

Dr. Noah N. Langdale, Jr., of Atlanta, Ga., president of the Georgia State College of Business Administration, addressed the annual Southern Forestry banquet. Conference speakers included Harley Langdale, Jr., president of the Langdale Company, and retiring president of the Forest Farmers Association; timber grower Fate Baker Everett; Dr. Clemens M. Kaufman, director of the School of Forestry, University of Florida; Prime F. Osborn, vice president and general counsel, Atlantic Coast Line Railroad Co.; Dr. Edward G. Locke, director of the U. S. Forest Products Laboratory; C. Huxley Coulter, state forester of Florida; H. D. Burkhalter, director, Forestry Division, T. L. James & Company; and Charles A. Connaughton, president of SAF, who addressed the convention on the challenge of cooperation to the professional forester.

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On the occasion of the annual Forest Farmers Association luncheon, state foresters in the 15 southern states served by the association were honored for outstanding contributions in protecting and developing the forest lands of the South. Also present—and honored—were more than a dozen former state foresters. All—present and past—received certificates of appreciation from the association.

Christmas Tree Growers to Hold National Meeting

The first convention of the National Christmas Tree Growers' Association, Inc. will be held August 25-27 at Purdue University, West Lafayette, Ind., according to a recent announcement by the association president, Daniel DenUyl, Department of Forestry and Conservation, Purdue University.

The National Christmas Tree Growers, organized at Butler, Pa., in 1955, is dedicated to furthering the over-all interests of the Christmas tree industry.

Timely topics relating to the industry will be discussed during the 3-day meeting by speakers of national promi-

nence in their fields and over 60 exhibits of products related to the Christmas tree industry will be on display. Approximately 1,000 Christmas tree growers and their families and friends are expected to be on hand for this first convention.

National Forest Products Week

The Hoo-Hoo International Wood Promotion Committee is sponsoring an industry-wide National Forest Products Week, October 16-22 of this year. R. W. Scott, Hoo-Hoo International president, has announced wide interest is being displayed throughout the wood-using industry for the "Week" by expression of support, endorsement, and plans to promote the program.

Seventh International Soil Science Congress

The Soil Science Society of America is sponsoring the 7th International Soil Science Congress in Madison, Wis., August 15-22. Some 400 scientific papers will be presented before an anticipated audience of 1,500. One pre-Congress and two post-Congress tours will be held, the latter intended primarily for the benefit of foreign visitors.

The first International Congress was held in Washingnton, D. C., in 1927. Subsequent Congresses were held in the USSR in 1930, England in 1935, Holland in 1950, Belgian Congo in 1954, and France in 1956.

Soil Conservation Society

The Soil Conservation Society of America will hold its 15th annual meeting on the campus of Ontario Agricultural College, Guelph, Ontario, Canada, August 28-31, 1960. This is the first time the Society has met in Canada.

"Theme of the 1960 meeting is 'New Technologies in Land Resource Management,' states Dr. Elmer L. Sauer, Urbana, Ill., president of the Society. Dr. Sauer also said development of the program for the meeting is under the direction of Prof. N. R. Richards, head, Department of Soils, Ontario Agricultural College, and R. D. Hockensmith, director, Soil Survey Operations, Soil Conservation Service, Washington, D. C.

Internationally known speakers from the United States and Canada will discuss the latest information in the field of land resource management and its application to soil and water conservation.

Private & Industrial

Crown Zellerbach Promotions Announced

Glen F. Hawkins, superintendent of Crown Zellerbach Corporation's Columbia County, Ore., logging division, will succeed E. S. Young as superintendent of the company's Tillamook division upon the retirement of Mr. Young on July 1.

Robert C. Lindsay, contract logging supervisor, Netarts tract, Tillamook Tree Farm, has been named Columbia division superintendent effective July 1.

Mr. Young joined Crown Zellerbach in 1944 after 23 years as a logging superintendent, engineer, and contractor in Washington and Oregon. In 1945 he was named superintendent of the company's Siltcoos division and has been directing the firm's Tillamook division, including the Tahkenitch, Lincoln, and Tillamook Tree Farm operations, since 1950. He is a logging engineer graduate of Oregon State College.

Hawkins has been with Crown Zellerbach since 1945, starting as resident logging supervisor at Vernonia. In 1958 he was promoted to the superintendent's position. He attended the University of Oregon and is a licensed logging engineer.

Lindsay has been with Crown Zellerbach since 1946 and served as resident forester of the Columbia division's Stamm Tree Farm for 11 years. Three years ago he moved to Portland as resident forester in the Northwest Timber department headquarters office. He was transferred to the contract logging supervisory post in Tillamook in 1959. Lindsay is a forestry graduate of Oregon State College.

C. G. Collard, resident engineer for Crown Zellerbach Corporation's Tillamook Division, has been appointed resident forest-engineer.

Collard will assume forestry responsibilities for the Tillamook Tree Farm formerly handled by E. B. Wycoff, Tillamook resident forester, who has been named timber evaluation engineer for the company's Northwest Timber department headquarters office in Portland.

A graduate of Oregon State College School of Forestry, Collard joined Crown Zellerbach in January 1946 as a surveyor at the company's Cathlamet, Wash., Tree Farm.

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bach at its Cathlamet, Wash. Division in 1942. He graduated from Oregon State College School of Forestry in 1946.

International Paper Company Promotions Announced

The promotion of O. G. Traczewitz to assistant chief forester of the Southern Kraft Division of International Paper Company was recently announced by Earl Porter, woodlands manager.

Traczewitz is from Milwaukee. He is a graduate of the University of Michigan, holding both a Bachelor of Science and a Master degree in forestry. He joined International Paper Company in 1941 as a timber cruiser in Sheridan, Ark. Since that time, he has served as administrative assistant, conservation forester, and division forester. At the time of his current promotion, he was regional forester of International's Georgetown, S. C., woodlands region.

In his new capacity, effective May 1, Traczewitz moved to Mobile, Ala., headquarters for International's Southern Kraft Division woodlands operations. His duties include the coordination of forest management activities on company-owned timberlands in ten southern states.

John R. Stone, forest superintendent of the Hot Springs woodlands area has succeeded Traczewitz as regional forester for the Georgetown region.

Stone is a native of Clyde, N. Y., and a graduate of the New York State College of Forestry. He joined International Paper Company in 1940 as a compassman and timber cruiser. He was made assistant division forester in 1953 and superintendent of the Hot Springs Woodlands Area in 1957.

St. Regis Forester Promoted

Lee D. Gardner, working circle forester on the Singing River lands, Crosby tract, has recently been appointed management forester for the Technical Control Section, Lands and Forest Department, Southern Woodlands Division of St. Regis Paper Co. with headquarters in Jacksonville, Fla.

Carl H. Struck, Jr., formerly with the St. Joe Paper Company, has been assigned as working circle forester on the Singing River Working Circle.

Gardner was graduated from New York State College of Forestry with a B.S. degree in 1940. His first assignment in the South was with the Florida Pulp and Paper Co. in January 1941. Joining the Westinghouse Electric

Corp. the following year, he then went with the St. Regis Paper Co. in January 1948. He was assigned to the Singing River Working Circle in August, 1957.

Schools

Purdue Holds Management Control Conference

Foresters from 23 states and three Canadian provinces attended the Purdue University Forest Management Control Conference, held February 15-17. The tenor of the conference stamps it as an important milepost on the road to new methods of forest management. The program included papers on the applications of linear programming in forest management decisions, use of digital computers to rapidly summarize data, permanent inventory plot techniques, questions of statistical reliability, income tax accounting, use of inventory data in directing forest management operations, and application of some of the mathematical techniques recently developed for industrial management. Thirty-eight speakers were on the program.

Keynoter Kenneth P. Davis and conference summarizer Arthur W. Nelson, Jr., reflected the widespread feeling that forest management is undergoing marked changes, as foresters in industry and government find themselves faced with mounting pressures on the resources they manage and the need to justify their activities in the competition for funds.

Proceedings will be published and made available to participants, as well as those making inquiry to the Department of Forestry and Conservation, Purdue University, Lafayette, Ind.

The conference was arranged by the following members of the Purdue faculty: O. F. Hall, general chairman; C. I. Miller, registration and meals; J. C. Callahan, publicity and recording; and C. M. Merritt, visual aids.

Special Field Institute in Forest Biology

The School of Forestry, North Carolina State College, Raleigh, N. C., will hold a Special Field Institute in Forest Biology July 25 to August 19, made possible by a grant from the National Science Foundation. Enrollment will be restricted to approximately 36 participants. Eight subject matter areas will be covered: forest biometry, forest ecology, forest entomology, forest genetics, forest growth-wood property interrelationships, forest patholgy, forest soils, and forest tree physiology. The institute will conduct formal lectures, discussions, seminars, and field trips.

Evans Establishes Scholarships at Oregon State College

E. S. Evans, Jr., president of the Evans Products Company, Plymouth, Mich., producers of plywood and other wood products, has announced that his company has established both an undergraduate scholarship and a graduate fellowship in forestry at Oregon State College at Corvallis.

The Evans' awards will become effective at the university starting with the fall term of 1960 and will be granted for an initial period of five years. They will include a $1,500 annual grant for graduate fellowship and a $750 annual grant for the undergraduate scholarship.

Each award will be made to an outstanding student in the School of Forestry by an appropriate faculty committee.

New York Establishes Forestry Extension Training

The State University College of Forestry at Syracuse University has announced the establishment of a new course entitled Interpreting Forestry to the Public. The elective course, for three hours credit, is offered to upper classmen and graduate students.

Objectives of the course are to give the student an appreciation of the importance of an enlightened public; a general knowledge of principles governing extension teaching; and a knowledge of the more important practices, methods, and media used in extension teaching. It is further intended that the course build within the student the ability to recognize opportunities to interpret forestry to the public,

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and to select and use the proper media for the job. Essentially a survey in scope, the course consists of 12 distinct but related units of teaching which are handled by five subject specialists from the Extension Department. Material is presented by two lectures and one three-hour laboratory period each week during one semester.

FOREST scientists and researchers at Oregon State College inspect their recent shipment of the first of two environmental growth chambers to be used in studies of the physiology of forest tree seedlings.

Shown from *left* to *right* are Dr. Irgens-Moller, forest geneticist; Dr. William Ferrell, forest physiologist; Kenneth Krueger, a graduate student working on forest ecology under a National Science Foundation grant; and Dr. George Barnes, assistant director of the forest researcher division of the agricultural experiment station.

More than $17,000 of special equipment has been purchased for use by the forest research division in continuing studies on environmental and hereditary variations in Douglas-fir. The project is partially financed by grants from the National Science Foundation.

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Public

Forest Supervisor Transfers Announced

Transfers involving two U. S. Forest Service officials from the Pacific Northwest Region and one from the Northern Region were announced by Regional Foresters J. Herbert Stone, Portland, Ore. and Charles L. Tebbe, Missoula, Mont. The transfers become effective in May.

George F. Roskie, a staff officer in the Division of Range and Wildlife Management, Portland, moved to Great Falls, Mont. as forest supervisor of the Lewis and Clark National Forest.

J. Malcolm Loring, who had been forest supervisor of the Malheur National Forest at John Day, Ore. since 1954, replaced Roskie in the Portland regional office.

John A. Fallman, the supervisor of the Lewis and Clark Forest, transferred to John Day, replacing Loring.

Madison River Canyon Earthquake Area Set Aside

The site of the spectacular land changes caused by the 1959 Montana earthquake has been set aside as the Madison River Canyon Earthquake Area, the U. S. Department of Agriculture announces.

Heart of the earthquake was in the Gallatin National Forest in Montana, and Richard E. McArdle, Forest Service chief, took necessary steps to protect the area, starting last August. A survey was made and boundaries established to include the slide which created the new Earthquake Lake, two major fault lines, and the blowout craters. The area is of geologic interest as an example of the gigantic forces which change the earth's surface.

The earthquake area lies north of Hebgen Lake and north and south of the new Earthquake Lake. It covers approximately 37,000 acres. Nearest towns are West Yellowstone and Ennis.

Mr. McArdle also set up a comprehensive plan for use of the area. It encompasses telling the story of the earthquake, development of recreation resources—including campgrounds for those who want to spend some time at the site, and protection of scientific values.

Route 287, main highway from the West leading into the earthquake area, will be repaired and relocated on the north side of the Madison River.

When the earth high on a mountain

some five miles downstream from Hebgen Dam gave way and slipped across the river, about 250 campers were trapped in the canyon. Most were rescued through joint efforts of the Forest Service and Montana state agencies. A bronze plaque will be placed on a shaftlike dolomite boulder in the canyon as a memorial to the known dead and to the unknown number buried in the slide.

Forest Researchers Transfer

Edward M. Gaines has been appointed to head the Ponderosa Pine Project of the National Log Grade Committee and Log Grade Task Force. He will be headquartered at the Pacific Southwest Forest and Range Experiment Station at Berkeley, Calif. For the past eight years he has been leader of the Rocky Mountain Forest and Range Experiment Station Research Center at Flagstaff, Ariz.

In his new position, Gaines will be in charge of development of log grades for ponderosa pine throughout the West.

He received his B.S. degree in Forestry from Washington State University in 1934 and began his career with the U. S. Forest Service in 1935.

Dr. Clifford A. Myers, Jr., project leader in forest management research for the Rocky Mountain Station at Rapid City, S. D., will succeed Gaines at Flagstaff. The transfer and promotion became effective May 15, according to Raymond Price, Station director.

Since 1955, Myers has been conducting forest management research in the Black Hills area.

A graduate of Colorado State University in Fort Collins, he received his Bachelor degree in forestry in 1942 and his Master degree in 1947. He received his Ph.D. from Yale University in 1959.

CLIFFORD A. MYERS, JR.

EDWARD M. GAINES

Ohio Assistant Forestry Chief Named

Robert B. Redett, formerly head of the Forest Protection Section of the Ohio Division of Forestry, has been named assistant chief of the division replacing Irving I. Dickman, who recently became chief of the Ohio Reclamation Division.

Redett, a native of Fredericksburg, Ohio, is a forestry graduate of Michigan State University. He has been with the Division of Forestry since 1946 after his discharge from the Navy.

W. E. Bullard Accepts Post in Guinea

William E. Bullard, Jr., left the Pacific Northwest Region of the Forest Service in April to accept a position in the Republic of Guinea under United Nations OPEX program according to Regional Forester J. Herbert Stone.

In his new position, Bullard will be engineer of water and forestry for the Government of Guinea. Guinea, formerly a French Colony, has become independent only within the past year and a half.

Bullard has been in charge of Small Watershed Projects in the Division of Watershed Management since 1957. Between 1935 and 1939, he worked with several government agencies, beginning his Forest Service career in 1939 with an appointment to the California Forest and Range Experiment Station.

For a three-month period in 1956, Bullard was detailed to the United Nations on a mission to Yugoslavia. He provided technical assistance on

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watershed protection, land use planning, forest grazing policy, and erosion control.

Join Coweeta Staff

Junior D. Helvey recently joined the staff of the Coweeta Hydrologic Laboratory, Franklin, N. C. The laboratory is operated by the Southeastern Forest Experiment Station., U. S. Forest Service.

Helvey is a native of West Virginia. He holds a B.S. degree in forestry from West Virginia University, and served with the U. S. Army for three years.

Prior to his transfer to Coweeta, Helvey was a research forester in the Butte Falls Ranger District, Butte Falls, Ore.

James H. Patric has transferred to Coweeta from the Pacific Southwest Forest and Range Experiment Station's San Dimas Experimental Forest, Glendora, Calif.

Patric is a native of Connecticut. He holds a B.S. in Forestry from the University of Connecticut and a Master of Forestry degree from Harvard. From 1943 to 1946, and again from 1951 to 1952, he served with the U. S. Navy.

Prior to joining the Pacific Southwest Station staff, Patric was employed by the Soil Conservation Service at Storrs, Conn., from 1948 to 1955.

G. D. Pickford Retires, Accepts Hawaiian Post

Retirement of Gerald D. Pickford from a staff position in the Division of Recreation and Lands of the Pacific Northwest Region of the U. S. Forest Service has been announced by Regional Forester J. Herbert Stone, Portland, Ore. Pickford has been head of the Section of Lands and Uses Management in the regional office since 1958.

Upon his retirement April 30 Pickford was slated to join the Hawaiian Division of Forestry, according to Mr. Stone. He will organize a forest research program and will work as forest ecologist under State Forester Walter W. Holt and Assistant State Forester Earl D. Sandvig who formerly was assistant regional forester at Portland.

Forester, B.S., 1959. Age 27, married, one child. Military duty completed. Experience: 4 months as compassman on road location. One summer with U. S. Forest Service in Northwest and 10 months as consulting forester. Work included timber management, cruising, appraisals, and timber sales. Desire position with private industry in New York or Northeast.
Box Z, Journal of Forestry, Mills Building, Washington 6, D. C.

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S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

Position Available

Humboldt State College has announced a vacancy for an assistant professor of forestry to be filled by September 1. Salary range is $6,060-$7,008 for academic year (9 months). Teaching specialities: forest engineering; forest mensuration, scaling and cruising; and forest mensuration, statistics and growth. Age under 45 preferred. Candidate who will have completed work for doctorate by September 1 is preferred. Address application with photograph to Dr. Homer P. Balabanis, dean of instruction, Humboldt State College, Arcata, California.

Positions Wanted

Forester, B.S. 1951, Auburn University. Age 30, married, five years experience with consulting forestry firm in the South. Experienced in all phases of forest management. Written and carried out management plans on large and small, industrial and private lands. Desires employment with southern industry with chance for advancement and responsibility.
Box U, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, BSF, Pa. State, 1950. Age 33, 4 children. 9 years timber management using CPI. Last 5 years including public relations with tenant farm and mineral lessees on 40,000 acres. Some experience in attracting new wood-users. Desire to relocate in Northeast or Mid-Atlantic States.
Box V, JOURNAL OF FORESTRY, Mills Bldg., Washington 6, D. C.

Forester, B.S., 1952, and graduate study in Wood Technology, 1954, Penn State, supplemented with courses in business and accounting. Also B.S. in Foreign Trade, 1960, The American Institute for Foreign Trade: Marketing, Foreign Trade, Spanish, Business Writing, Management and Human Relations, and International Law. Organizational and administrative abilities. Four years experience in tropical West Africa. Age 29, married.
Box W, JOURNAL OF FORESTRY, Mills Bldg., Washington 6, D. C.

Forester B.S., 1957, Colorado State University. Age 25, single. Experience 3½ years with Bureau of Land Management (Reforestation, Inventory, Forest Road Engineering including Direct Location, semi-detailed road design, road construction appraisals, inspecting timber sale contract road construction, also limited timber appraisal work.) Desires employment with private industry.
Box X, JOURNAL OF FORESTRY, Mills Bldg., Washington 6, D. C.

Forester, B.S.F. 1954, University of Michigan. Age 28, single. Experience: 14 months with Soil Conservation Service. Presently employed with private company in Lake States area. Experience in woodland operations and procurement. Desire position with progressive pulp and paper company.
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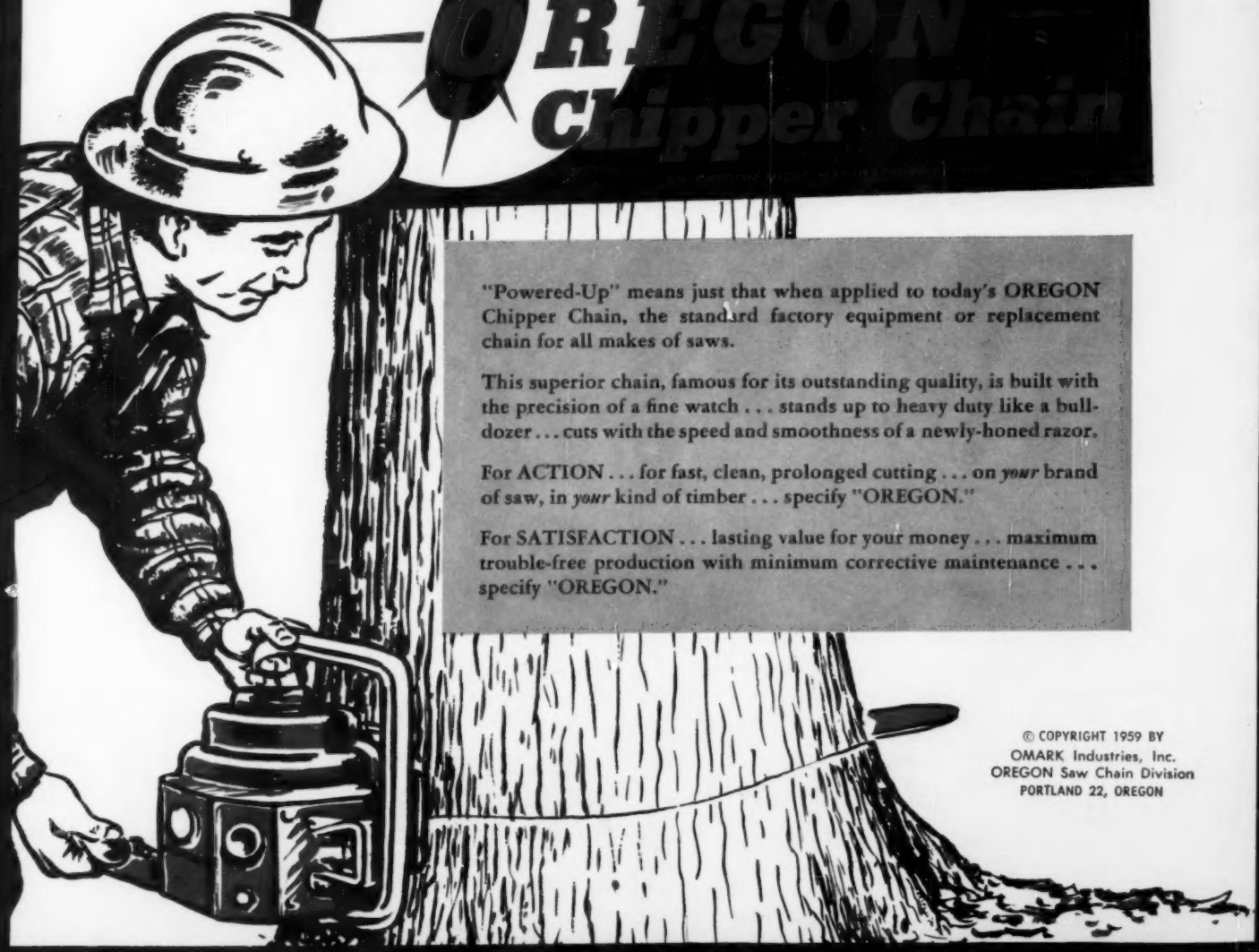

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Russell Ost, Fleet Superintendent

SKIDS AND DECKS TREE-LENGTH LOGS WITH D6B TRACTOR

"YOU CAN'T BEAT IT FOR LOGGING"

Most recent acquisition of the W. T. Smith Lumber Co., Chapman, Alabama, is a 93 HP D6B Tractor equipped with a Balderson Blade*. This machine joins with another D6, two D4s and a wheeled skidder to handle trees up to 40 inches in diameter and 60 feet in length. Skidding 400 to 800 feet over hilly, wet terrain, the D6 averages 2000 board feet per hour. Production of the crew, working 9 hours a day, 5 days a week, is between 200,000 and 250,000 board feet.

Although the new D6 has been on the job only a short time, it already has a reputation as an ideal woods tractor. Mr. Russell Ost, Fleet Superintendent, singles out the service-free lifetime lubricated track rollers as one reason. "There's no possible way for contamination—any time you have grease, dirt is bound to stick to it and enter the roller with the grease." And he likes the idea of using Series 3 oil throughout the machine. "It means you don't have to carry 3 kinds of oil on your truck." W. E. Parmer, woods foreman, adds, "You can't beat the D6 for this logging!"

How long since you've taken a good hard look at your equipment? It may be that the new D6B would increase your profit far more than you imagine. Your Caterpillar Dealer knows logging. Get the facts from him and ask him to demonstrate the new D6B. Say when and where, he'll be there!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

NEW WORK-STYLED D6 SERIES B

NOW 25% MORE LUGGING ABILITY – new Cat D333 Diesel Engine delivers 93 HP at the flywheel.

NEW INTEGRAL HYDRAULIC SYSTEM – engine-mounted pump, dash-mounted hydraulic tank free front and rear of tractor for attachments.

NEW OPERATOR CONVENIENCE – controls let one motion flow into the next to speed every operation.

NEW DRY-TYPE AIR CLEANER – removes 99.8% of all dirt from diesel intake air, even in the worst dust conditions. Serviced in just 5 minutes.

NEW HYDRAULIC TRACK ADJUSTERS (optional) – save maintenance time. A few strokes from the grease gun are all that's needed to assure proper track tension.

NEW LIFETIME LUBRICATED TRACK ROLLERS with exclusive patented floating ring seals never need servicing.

PLUS THE EXCLUSIVE OIL CLUTCH – 2000 hours' service or more without adjustment.

*Manufactured by Balderson, Inc.

CATERPILLAR

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MODERN HEAVY-DUTY LOGGING MACHINES FOR HARD WORK